
User's Manual

Model PH100 Panel Mount pH Converter

IM 12B11A01-01E

◆ Introduction

This manual covers the specifications, installation, operation and maintenance of the panel-mount version of the PH100 pH converter. Please read this before using the PH100. There are manuals for the related EXA100 series as follows:
Refer to them as required.

Model code	Manual Name	IM No.
PH100	Panel Mount pH Converter	IM 12 B11A01-01E
OR100	Panel Mount ORP Converter	IM 12 C11A01-01E
SC100	Panel Mount Conductivity Converter	IM 12 D11A01-01E
PH10FP	KCl Refillable pH Sensor	IM 12 B11C01-01E
PH10RP	KCl Replenish-free pH Sensor	IM 12 B11C02-01E
OR10FP	KCl Refillable ORP Sensor	IM 12 C11C01-01E
OR10RP	KCl Replenish-free ORP Sensor	IM 12 C11C02-01E
SC10XB	Conductivity Sensor for SC100	IM 12 D11C01-01E
WTB100	Terminal Box for EXA100	IM 12 B11E01-01E
WF100	Extension Cable for EXA100	IM 12 B11F01-01E
PH10HLD	Immersion Holder for EXA100	IM 12 B11D01-01E
PH10HG	Guide-pipe Holder for EXA100	IM 12 B11D02-01E

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◆ For the safe use of this equipment

(1) About This Manual

- This manual should be passed on to the end user.
- The contents of this manual are subject to change without prior notice.
- The contents of this manual shall not be reproduced or copied, in part or in whole, without permission.
- This manual explains the functions contained in this product, but does not warrant that they will suit the particular purpose of the user.
- Every effort has been made to ensure accuracy in the preparation of this manual. However, should any errors or omissions come to the attention of the user, please contact the nearest Yokogawa Electric representative or sales office.
- This manual does not cover the special specifications. This manual may be left unchanged on any change of specification, construction or parts when the change does not affect the functions or performance of the product.
- If the product is used in a manner not specified in this manual, the safety of this product may be impaired.

(2) Safety and Modification Precautions

- Follow the safety precautions in this manual when using the product to ensure protection and safety of personnel, product and system containing the product.

(3) The following safety symbols are used on the product as well as in this manual.



DANGER

This symbol indicates that the operator must follow the instructions laid out in this manual in order to avoid the risk of personnel injury, electric shock, or fatalities. The manual describes what special care the operator must exercise to avoid such risk.



WARNING

This symbol indicates that the operator must refer to the instructions in this manual in order to prevent the instrument (hardware) or software from being damaged, or a system failure from occurring.



CAUTION

This symbol draws attention to information essential for understanding the operation and functions.



Tip

This symbol gives information that complements the current topic.



SEE ALSO

This symbol identifies a source to which to refer.



Protective Ground Terminal



Function Ground Terminal (Do not use this terminal as the protective ground terminal.)



Alternating current

◆ NOTICE and Cautions

- Check specifications

When the instrument arrives, unpack the package with care and check that the instrument has not been damaged during transportation. In addition, please check that the specification matches the order, and required accessories are not missing. Specifications can be checked by the model codes on the nameplate. Refer to Chapter 1.2 Specifications for the list of model codes.

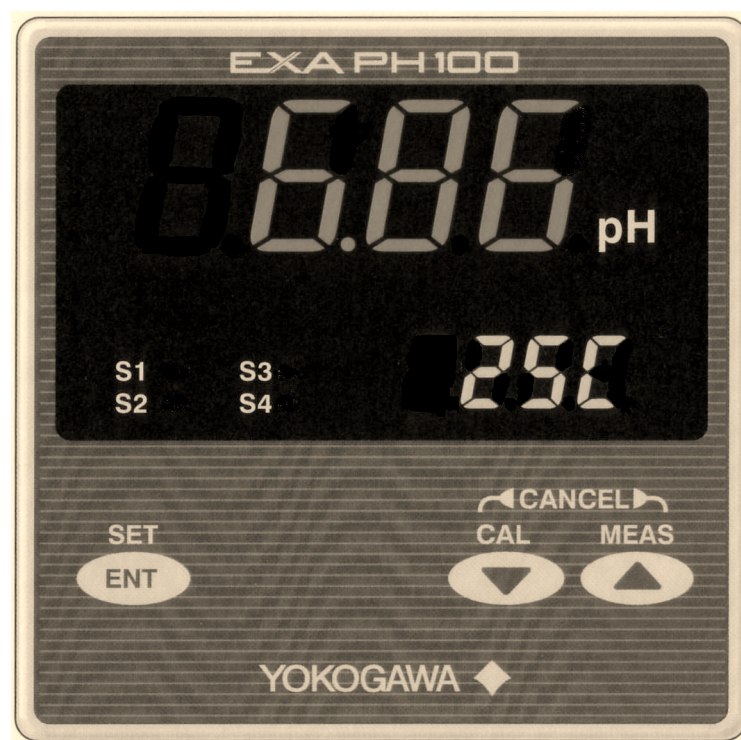
- Details on operation parameters

When the PH100 panel mount pH Converter at the user site, it will operate based on the operation parameters (initial data Table 5.1 to 5.5) set before shipping from the factory.

Ensure that the initial data is suitable for the operation conditions before conducting analysis. Where necessary, set the instrument parameters for appropriate operation. For details of setting data, refer to chapters 4 to 5.

When user changes the operation parameters, it is recommended to note down the changed setting data.

Front Panel of PH100



LED Display Symbols

- Alphanumerics are represented as follows on the LED display

Alphanumerics	LED Display	Alphanumerics	LED Display	Alphanumerics	LED Display
<i>A</i>	<i>A</i>	<i>N</i>	<i>n</i>	0	<i>0</i>
<i>B</i>	<i>b</i>	<i>O</i>	<i>o</i>	1	<i>1</i>
<i>C</i>	<i>C</i>	<i>P</i>	<i>P</i>	2	<i>2</i>
<i>D</i>	<i>d</i>	<i>Q</i>	<i>q</i>	3	<i>3</i>
<i>E</i>	<i>E</i>	<i>R</i>	<i>r</i>	4	<i>4</i>
<i>F</i>	<i>F</i>	<i>S</i>	<i>S</i>	5	<i>5</i>
<i>G</i>	<i>G</i>	<i>T</i>	<i>t</i>	6	<i>6</i>
<i>H</i>	<i>H</i>	<i>U</i>	<i>U</i>	7	<i>7</i>
<i>I</i>	<i>I</i>	<i>V</i>	<i>V</i>	8	<i>8</i>
<i>J</i>	<i>J</i>	<i>W</i>	<i>W</i>	9	<i>9</i>
<i>K</i>	<i>K</i>	<i>X</i>			
<i>L</i>	<i>L</i>	<i>Y</i>	<i>Y</i>		
<i>M</i>	<i>M</i>	<i>Z</i>	<i>Z</i>		

◆ After-sales Warranty

- During the warranty period, for repair under warranty carry or send the product to the local sales representative or service office. Yokogawa will replace or repair any damaged parts and return the product to you.
- Before returning a product for repair under warranty, provide us with the model name and serial number and a description of the problem. Any diagrams or data explaining the problem would also be appreciated.
- If we replace the product with a new one, we won't provide you with a repair report.
- Yokogawa warrants the product for the period stated in the pre-purchase quotation. Yokogawa shall conduct defined warranty service based on its standard. When the customer site is located outside of the service area, a fee for dispatching the maintenance engineer will be charged to the customer.
- In the following cases, customer will be charged repair fee regardless of warranty period.
 - Failure of components which are out of scope of warranty stated in instruction manual.
 - Failure caused by usage of software, hardware or auxiliary equipment, which Yokogawa Electric did not supply.
 - Failure due to improper or insufficient maintenance by user.
 - Failure due to modification, misuse or outside-of-specifications operation which Yokogawa does not authorize.
 - Failure due to power supply (voltage, frequency) being outside specifications or abnormal.
 - Failure caused by any usage out of scope of recommended usage.
 - Any damage from fire, earthquake, storms and floods, lightning, disturbances, riots, warfare, radiation and other natural changes.
- Yokogawa does not warrant conformance with the specific application at the user site. Yokogawa will not bear direct/indirect responsibility for damage due to a specific application.
- Yokogawa Electric will not bear responsibility when the user configures the product into systems or resells the product.
- Maintenance service and supplying repair parts will be covered for five years after the production ends. For repair for this product, please contact the nearest sales office described in this instruction manual.

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1. Overview

1.1 EXA PH100 pH converter

The EXA PH100 pH converter is a panel-mount unit with built-in general-purpose preamp, large 4-digit LED display for measured value and 4-digit LED display for settings.

1.2 Check the specifications

The model number and suffix codes are shown below. Check that what you were supplied is the same as what you ordered.

Model	Suffix code	Option code	Description
PH100			Panel mounted pH converter
_____	-A		Always -A
Label language	-E		English
	-J		Japanese
Contact output	-21		2 contact outputs
	-41		4 contact outputs
Temperature sensor	-T1		Pt1000/Pt100
	-T2		Pt1000/500 Ω
	-T3		Pt1000/10 k Ω
	-T4		Pt1000/6.8 k Ω
_____	-NN		Always -NN
Option	Construction	/65	IP65

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1.3 Features of the EXA PH100 pH converter

- (1) Large 4-digit display. Both measured pH value and temperature can be displayed at the same time.
- (2) You can easily calibrate the unit with pH4, pH7 or pH9 standard solution.
- (3) You can select either two output contacts or four ; and you can select each contact output type from : high, low, high high, low low, and high high / low low.
- (4) Isolated 4 to 20 mA analog output of measured value.
- (5) Calibration values and measured values can be read to 0.01 pH, making high accuracy measurement and calibration possible.
- (6) The operation panel is rated for operation in an IP55. IP65 is optional.
- (7) 96 mm x 96 mm DIN size panel mount instrument. Depth is 120 mm and weight is 600 g.
- (8) Full set of self-diagnostic functions with indication of errors such as measurement out of range, converter abnormal, calibration-time error.

1.4 Standard Specifications

Measurement : Hydrogen ion concentration (pH) of a solution

Measuring range : -2.00 to 14.00 pH Indication

Display

Display : Digital (LED)

Range : -2.00 to 16.00 pH

Resolution : 0.01 pH (pH reading), 1 °C (temperature reading)

Indication items : pH reading, setting, status, temperature *¹

*¹: Indication “enabled/disabled” selectable

Input signal

pH input range : -2 to 16 pH

pH input impedance : $10^{12} \Omega$ or more

Temperature input *² : Pt1000/Pt100, Pt1000/500 Ω , Pt1000/10 k Ω , Pt1000/6.8 k Ω

*² : Must be specified when ordering.

Temperature input range : -10 to 110 °C

Transmission signal output

Number of output points : 1 output, pH reading only

Output signal : 4 to 20 mA DC, isolated

Load resistance : 600 Ω or less

Transmission signal range : Configurable within pH-2.0 to pH 16.0 (Default : pH0.0 to pH 14.0)

Minimum span : 2 pH

Maintenance output signal : Output hold “enabled/disabled” selectable

Hold output value : Last measured value/preset value (2.0 to 20.8 mA) selectable

Fail output signal : Downscale burnout (2 mA) “enabled/disabled” selectable

Contact output

Contact type : Relay contact output

Number of contacts : 2 or 4 outputs (must be specified when ordering)

Contact action : On/Off action

Contact functions : Selectable; High, low, high-high, low-low, high-high/low-low limit alarms, FAIL

Contact output hysteresis : 0.0 to 4.0 pH (configurable)

Contact output delay time : 0 to 200 seconds (configurable)

Contact rating : When 2 contact outputs specified

S1 : 240 VAC 3A or 30 V DC 3A (resistance load), Form C (NC/NO/COM, 3 terminals)

S2 : 240 VAC 3A or 30 V DC 3A (resistance load), Form A

When 4 contact outputs specified

S1 : 240 VAC 3A or 30 V DC 3A (resistance load), Form C (NC/NO/COM, 3 terminals)

S2, S3, S4 : 240 V AC 3A or 30 V DC 3A (resistance load), Form A, shared common
Maximum load current on common is 3A.

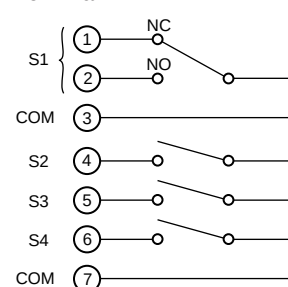
Contact status:

Table 1.1

Contact		Function selected					
		H, L, HH, LL, HH/LL limit alarms			FAIL		
		Power off	Power on		Power off	Power on	
			No alarm	Alarm		No alarm	Alarm
S1	NO-COM	Open	Open	Closed	Open	Closed	Open
	NC-COM	Closed	Closed	Open	Closed	Open	Closed
S2		Open	Open	Closed	Open	Closed	Open
S3 when specified		Open	Open	Closed	Open	Closed	Open
S4 when specified		Open	Open	Closed	Open	Closed	Open

Note: When a contact is activated, the LED on display panel turns on.

Terminal



Ambient temperature : -5 to 45 °C

Storage temperature : -25 to 70 °C

Ambient humidity : 10 to 90% RH, non-condensing

Installation altitude : 2000 m or less above sea level

Construction : Front panel : Dust-proof and drip-proof construction IP55,
IP65 (when "/65" option specified)

Materials : ABS resin and polycarbonate

Power supply : Rated voltage 100 to 240 V AC ($\pm 10\%$), 50/60 Hz

Power consumption : Max. 9 VA

Weight : Approx. 600g

Dimensions : 96 (W) $\times$ 96 (H) $\times$ 120 (D) mm

Mounting : Panel mount

Panel cutout dimensions : 92 (W) $\times$ 92 (H) mm

Wiring : M3.5 screw terminal

Grounding : grounding resistance 100 Ω or less

Functional specifications

Asymmetry potential adjustment range : 7 ± 2 pH

Slope adjustment range : 70 to 110% of theoretical value

Automatic temperature compensation range : -10 to 110 °C, manual temperature compensation available (setting range : -10 to 110 °C)

Temperature correction function (cable length correction by one-point temperature calibration)

Calibration function

One touch automatic calibration (one or two point calibration)

Standard solution table : Selectable : JIS • NIST Table (4, 7, 9 pH)

DIN 19267 Table (4, 7, 9 pH)

US Technical Buffer Table (4, 7, 10 pH)

Standard solution temperature range : 0 to 95 °C for JIS • NIST Table

0 to 90 °C for DIN 19267 Table

0 to 60 °C for US Technical Buffer Table

Manual calibration (one or two point calibration at specified setpoint(s))

Self-diagnostics function

FAIL output : pH measurement range failure, temperature measurement range failure, temperature detection element failure, and converter failure

Detection during calibration, error indication :

Standard solution temperature range failure, asymmetry potential failure, electromotive force slope failure, stability failure

Converter performance : under normal operating conditions

Linearity : ± 0.03 pH

Repeatability : ± 0.02 pH

Transmission output accuracy : $\pm 0.3\%$ of span

Sensors connectable with PH100 : PH10FP, PH10RP, PH8EFP, PH8ERP, FU20 (no ORP measurement available)

Sensors conditionally connectable : PH8ERG, PH8EFG, other companies' sensors (no temperature compensation available, manual temperature compensation required)

Maximum total connection cable length : 50 m (sensor cable length included)

2. Preparation for Operation

2.1 Unpacking

When the instrument arrives, unpack the package with care and check that the instrument has not been damaged during transportation. In addition, please check that the specification matches the order, and required accessories are not missing.

2.2 Choosing an Installation Location



WARNING

To minimize the danger of shock, the converter should be mounted on the converter panel before power is applied.

When choosing a mounting location: Mounting Cautions

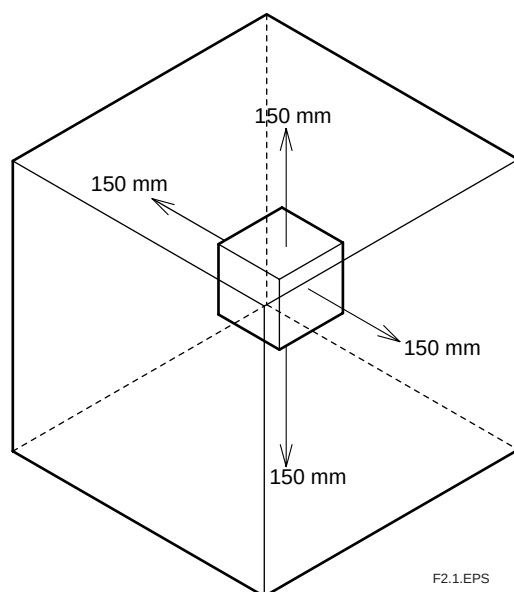


CAUTION

- (1) Mount the converter in a location which allows adequate space for access from the rear for wiring and the like,
 - (2) Ideally the converter should be on the rear of a panel, so that unauthorized personnel will not have access to the terminals,
 - (3) It should be a place with minimal vibration,
 - (4) It should not be exposed to corrosive gas atmospheres,
 - (5) Temperature should be near normal (23 °C) with minimal change,
 - (6) Humidity should be between 10% and 90% RH,
 - (7) The converter should not be exposed to direct heat radiation,
 - (8) The converter should not be exposed to strong magnetic fields,
 - (9) The converter should not be exposed to moisture,
 - (10) The converter should not be mounted near flammable materials,
 - (11) The converter should not be exposed to strong UV light.
-

The case of the converter is made of flammable polycarbonate resin, and the bezel is flammable ABS resin, so the converter should not be mounted above flammable materials.

If there will be flammable materials in the vicinity, they should be separated from the converter top, bottom, left and right sides by a clearance of at least 150 mm, and the converter covered by a plated steel plate at least 1.43 mm thick, or an uncoated steel plate of thickness 1.6 mm.

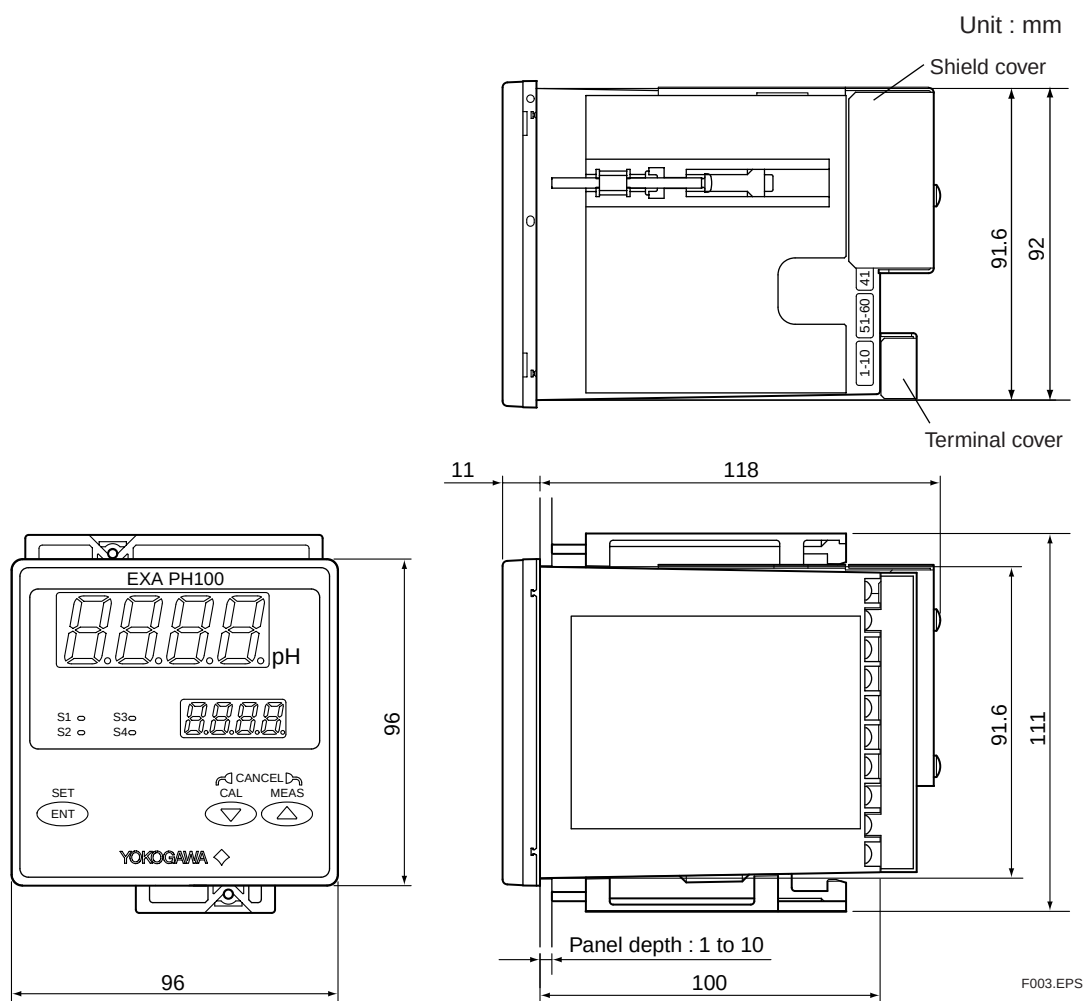


F2.1.EPS

Fig. 2.1

2.3 External Dimensions

• pH Converter



F003.EPS

Fig. 2.2

2.4 Panel Cutout Dimensions

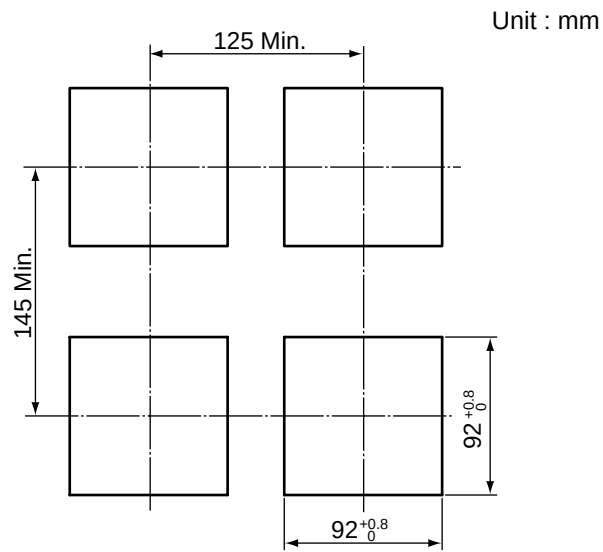


Fig. 2.3

2.5 Mounting

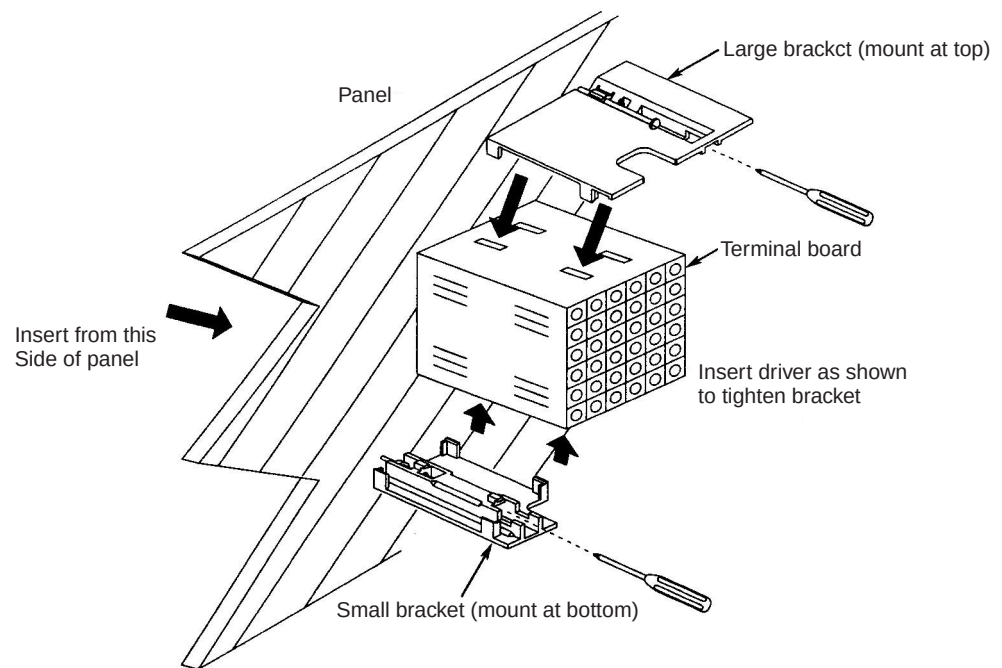


Fig. 2.4

Procedure 1

Cut out panel to mount instrument, cut out dimensions are shown on previous page.

Procedure 2

Insert rear of instrument (terminal block side) in panel cutout.

Procedure 3

Mount top and bottom brackets (see figure) to fix instrument to panel.

*When detector output is to be prewired, refer to Sec. 3.4(2)



WARNING

If instrument is a tight fit in cutout, do not force it as case or mounting brackets may be damaged.

WARNING

The instrument may be installed with the rear inclined at an angle up to 30° below front.
Do not incline with front below rear.

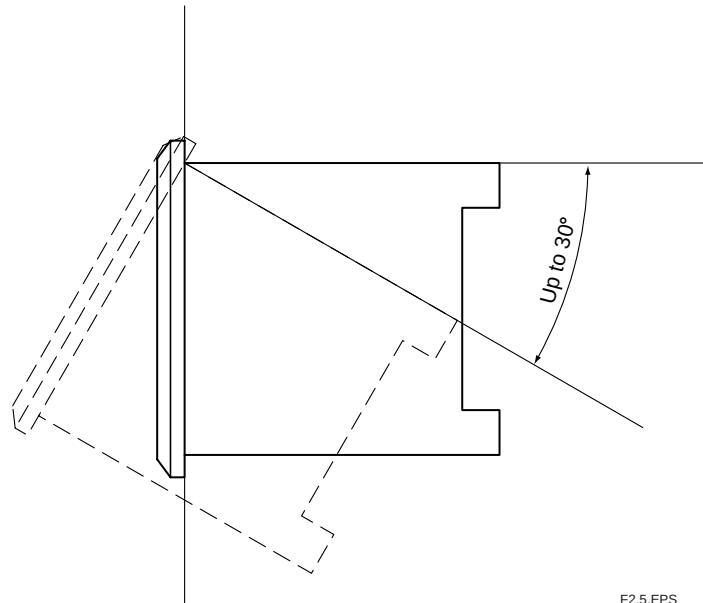


Fig. 2.5

3. Wiring

This section explains wiring of the EXA PH100 pH converter.

 WARNING

Be sure to turn off power supply, and check with a tester or the like that connected cables do not have dangerous voltages applied. Do not touch terminals if power may be applied.

The recommended specifications for wiring terminals are shown below.
Use crimp-on terminals, designed to fit an ISO M3.5 screw, with an insulating sleeve.

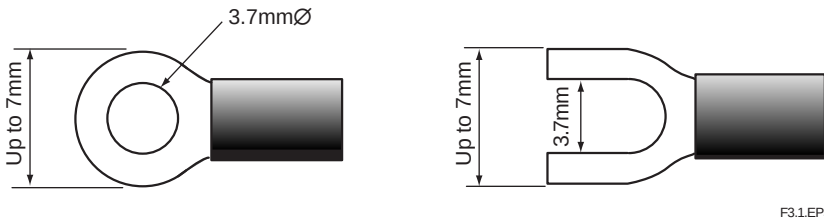


Fig. 3.1

● Recommended terminals

Table 3.1

Maker	model	For wire size:	Tightening torque
Japan AMP Co., Ltd	1.25-YS3A	0.3~1.65mm	0.8N · m (8 kgf · cm) Up to or less
JST Co., Ltd	YD1.25-3.5		

T3.1.EPS

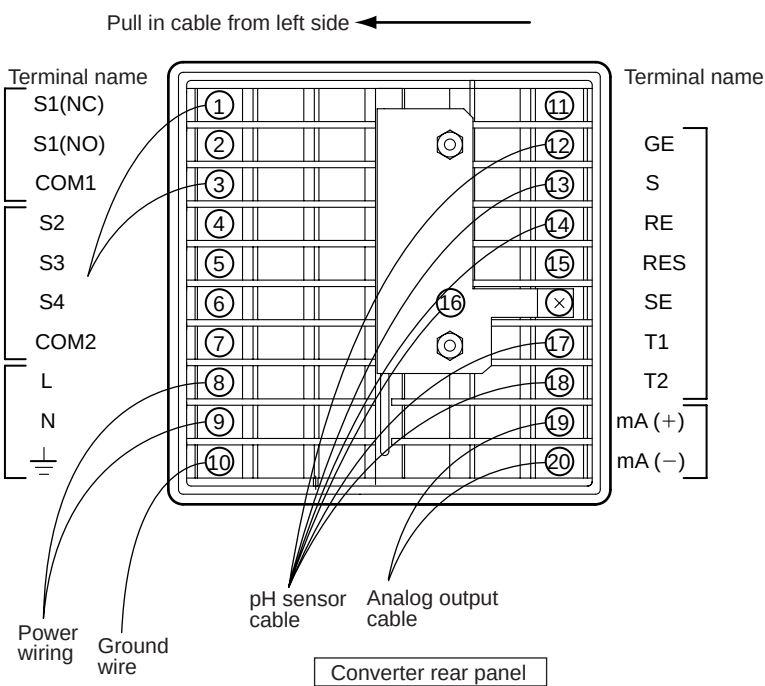
3.1 Pulling in Wiring

When wiring cables to terminals on the rear of the instrument, pull the cables into the instrument in the direction shown in Fig. 3.2



CAUTION

There's a terminal wiring diagram on the instrument nameplate on the side of the instrument.



F3.2.EPS

Fig. 3.2 Direction to pull in wiring

3.2 Noise prevention

● Noise sources

The following are typical sources of electrical noise

- * Relays and contacts
- * Solenoid coil, solenoid valve
- * Power lines
- * Inductive loads
- * Inverters
- * Motor commutators
- * SCRs used for phase-angle control
- * Wireless transmitters
- * Welding equipment
- * High-voltage ignition systems

● Noise prevention

When wiring, take the following precautions to minimize the effects of noise:

- * Keep input circuit wiring as far as possible from power or ground wiring.
- * Shielded wires, with single-point grounding, are effective for minimizing pickup of static electric fields.
- * Twisted pair wire is effective in minimizing inductive noise pickup.

3.3 Wiring Terminal Diagram

There are wiring terminals on the rear of the PH100 converter. Wire to terminals 1 to 10 and terminals 11 to 20 as shown in Fig. 3.3. The terminal block cannot be removed.

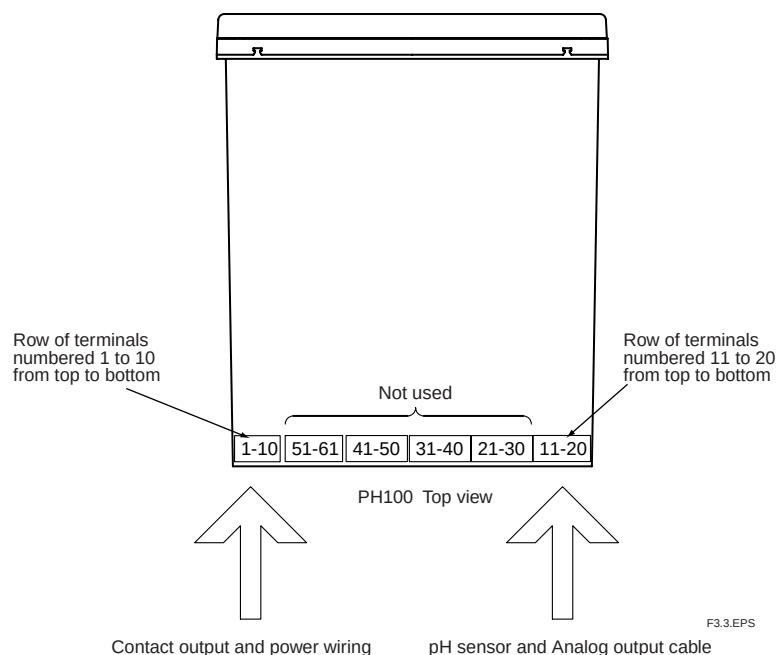


Fig. 3.3 Cable wiring position

(1) When intermediate terminal box is used



CAUTION

Terminal size is ISO M3.5. There's a terminal wiring diagram on the instrument nameplate on the side of the instrument.

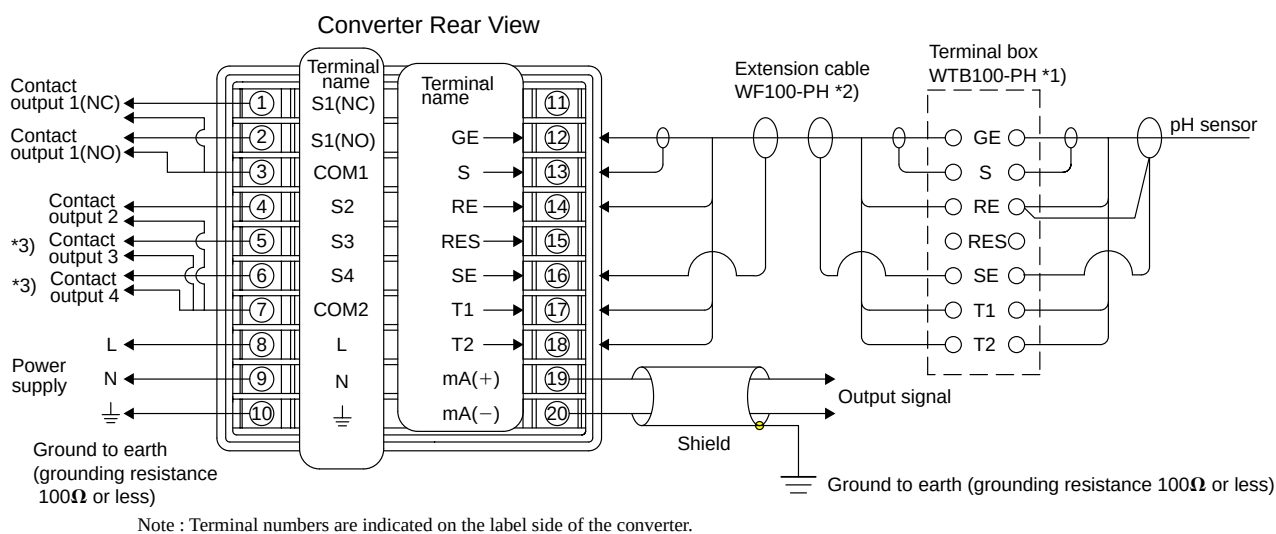


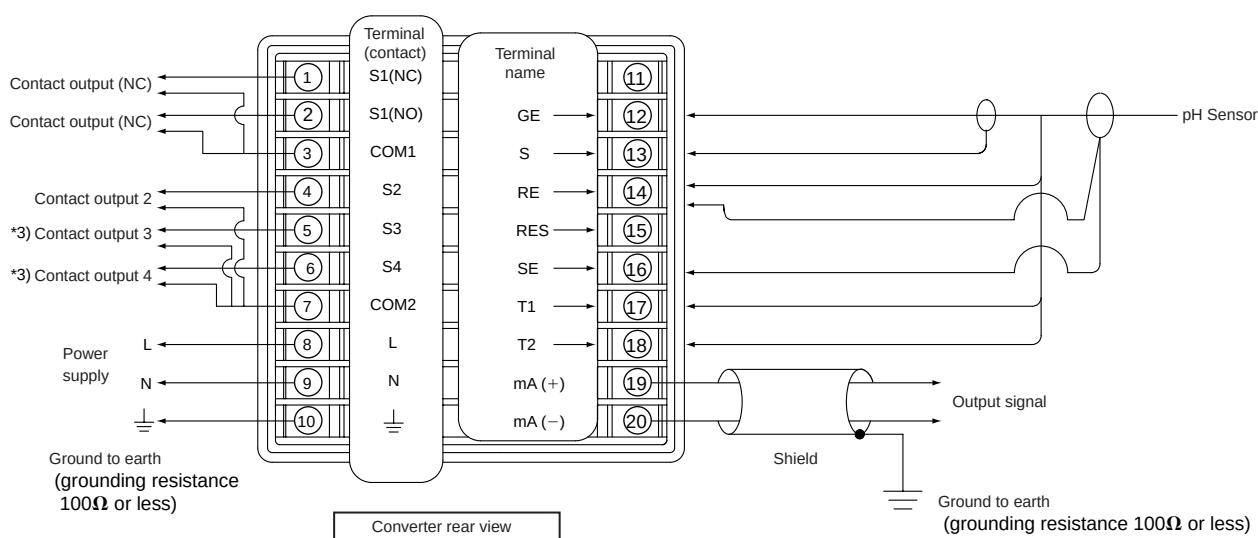
Fig. 3.4 Wiring diagram when intermediate terminal box is used

(2) When intermediate terminal box is not used



CAUTION

Terminal size is ISO M3.5. There's a terminal wiring diagram on the instrument nameplate on the side of the instrument.



F3.5.EPS

Fig. 3.5 Wiring diagram when intermediate terminal box is not used

- *1) Intermediate terminal box WTB100 is used when pH converter and pH sensor are far apart.
- *2) Extension cable WF100 is used when pH converter and pH sensor are far apart.
- *3) When only two contact outputs are specified, contact outputs 3 and 4 (S3 and S4) are not used. When four contact outputs are used, S3 and S4 share the same common lead (COM2).

Table 3.2 Terminal wiring example

Terminal no.	Signal name	Signal description
1	S1(NC)	Contact output 1 (relay contact) NC
2	S1(NO)	Contact output 1 (relay contact) NO
3	COM1	Contact output 1 (common)
4	S2	Contact output 2 (relay contact)NO
5	S3	Contact output 3 (relay contact) NO
6	S4	Contact output 4 (relay contact) NO
7	COM2	Contact output 2 (common) (shared by S2,S3 & S4)
8	L	Power line L
9	N	Power line N
10	$\frac{1}{\text{—}}$	Ground
11	—	Reserved
12	GE	Glass electrode input terminal
13	S	Glass electrode shield terminal
14	RE	Reference electrode input terminal
15	RES	Reference electrode shield terminal
16	SE	Ground electrode (cable shield) terminal
17	T1	Temperature input terminal
18	T2	Temperature input terminal
19	mA(+)	Analog output terminal (+)
20	mA(—)	Analog output terminal (—)

T3.2.EPS

**CAUTION**

Figures 3.4 and 3.5 seem to indicate that cable can be pulled in from right hand side, but in fact cable can only be pulled in from left hand side as described in Sec. 3.1

3.4 pH detector wiring

This section describes connection of the Model PH10FP KCl Refillable pH sensor or the Model PH10RP KCl Replenish-free pH sensor to the EXA PH100 pH converter.



CAUTION

For a description of how to connect these sensors via extension cable and intermediate terminal box, refer to IM 12B11E01-01E for the EXA WTB100 intermediate terminal box, and refer to IM 12B11F01-01E for the EXA WF100 extension cable.

The procedure for connecting a sensor to the EXA PH100 pH converter is as follows:

- (1) Loosen the two holding screws to remove the shielding cover (which covers the terminals used for connecting a pH detector) from the rear of the EXA PH100 pH sensor.
- (2) Connect the pH sensor (detector) by cable to the terminals. The color coding of the wires in the cable and the corresponding terminals that they are connected to are listed below:

① <u>pH converter terminal no.</u>	<u>Cable core color code for PH10FP and PH10RP pH sensors</u>
11	Do not use
12	Red (GE)
13	Yellow (S)
14	Brown (RE) two wires
15	Do not use
16	Green (SE)
17	White (T1)
18	Black (T2)

② <u>pH converter terminal no.</u>	<u>Cable core color code for PH8EFP and PH8ERP pH detectors</u>
11	Do not use
12	Red (GE)
13	Yellow (S)
14	Brown (RE)
15	Do not use
16	Green (SE)
17	White (T1)
18	Black (T2)



CAUTION

When using the PH8EFP or PH8ERP which have pin terminals, be sure to replace the SE pin terminal with a forked terminal, as if you use the pin terminal is prone to pulling out, resulting in unreliable measurements.

③ pH converter terminal no.	<u>Cable core color code for PH8EFG and PH8ERG pH detectors</u>
11	Do not use
12	Red (GE)
13	Yellow (S)
14	Brown (RE)
15	Do not use
16	Green (SE)
17	White (T1)
18	Black (T2)



CAUTION

When using the PH8EFG or PH8ERG which have pin terminals, be sure to replace the SE pin terminal with a forked terminal, as if you use the pin terminal is prone to pulling out, resulting in unreliable measurements. You can't measure temperature by connecting ... to T1, T2 -- use manual temperature compensation.

④ pH converter terminal no.	<u>Cable core code for FU20 pH detectors</u>
11	Do not use
12	15 (GE)
13	16 (S)
14	13 (RE)
15	Do not use
16	14 (SE)
17	11 (T1)
18	12 (T2)



CAUTION

FU20 cable core numbers do not agree with converter terminal numbers, so care is required.

- (3) Use wiring clips to hold the pH sensor cable in place.
- (4) Replace the shielding cover removed instep (1) above. Be careful not to pinch the sensor wiring with the cover when replacing it.

3.5 Wiring cable to intermediate terminal box

When the EXA PH100 pH converter is separated by a distance from the pH detector, use the EXA WTB100 terminal box and EXA WF100 extension cable to connect them.

3.6 Output Signal Cable Wiring



DANGER

To minimize the danger of shock, before connecting or disconnecting wires be sure to confirm that the pH converter power is OFF.

The output signal wiring from the PH100 converter connects to recorders or the like. Use two-core shielded cable for this wiring.

- (1) Connect connecting cable to the terminals. Be sure to use the recommended terminals and be sure that they are the correct size for the cable copper core diameter.
- (2) As shown in Figures 3.4 and 3.5 of Section 3.3, ground to earth and ground connection at one point only.

3.7 Contact output wiring.

3.7.1 Wiring when S1 is used

A terminal cover is fitted to reduce the risk of electric shock when power is applied. When connecting contact output wiring, you need to loosen the two cover screws to remove the cover. After completing the wiring, take care not to forget to replace the cover.

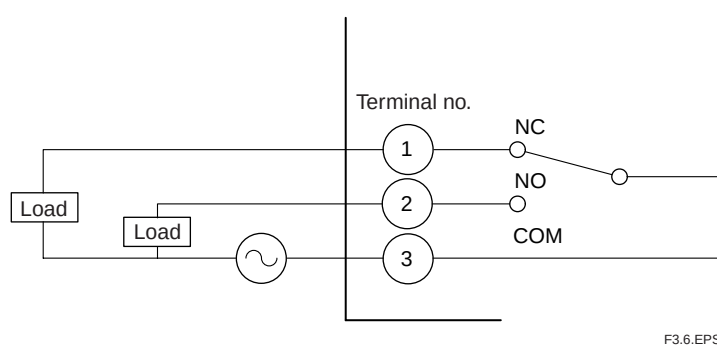


Fig. 3.6 Relay contact output wiring

- * If you want to connect a load which exceeds the contact rating (voltage rating 240 V AC, current rating 3A resistive load, 30 VDC 3A resistive load) then you need to use a slave relay.
- * If you connect an inductive load like a solenoid valve or slave relay then in parallel with the contacts you should connect a CR filter (when switching AC) or a diode (when switching DC), or contact life may be affected.

WARNING

* Be sure to disconnect power before removing the terminal cover. Since there is the danger of shock, turn off power and confirm that terminals are not live before wiring. Under no circumstances should terminals be touched when power is applied.

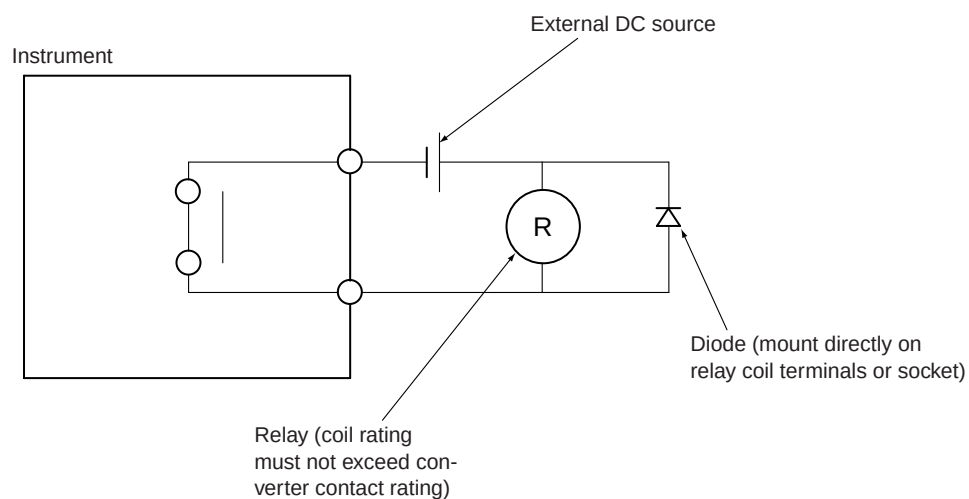
Recommended CR filters

Table 3.3

Maker	Models
MATSUO Electric co.,Ltd	CR UNIT 953, 955 etc.
SHIZUKI Electric co.,Ltd	SKV, SKVB etc.
RUBYCON Corporation	CR-CFS, CR-U etc.

T3.3.EPS

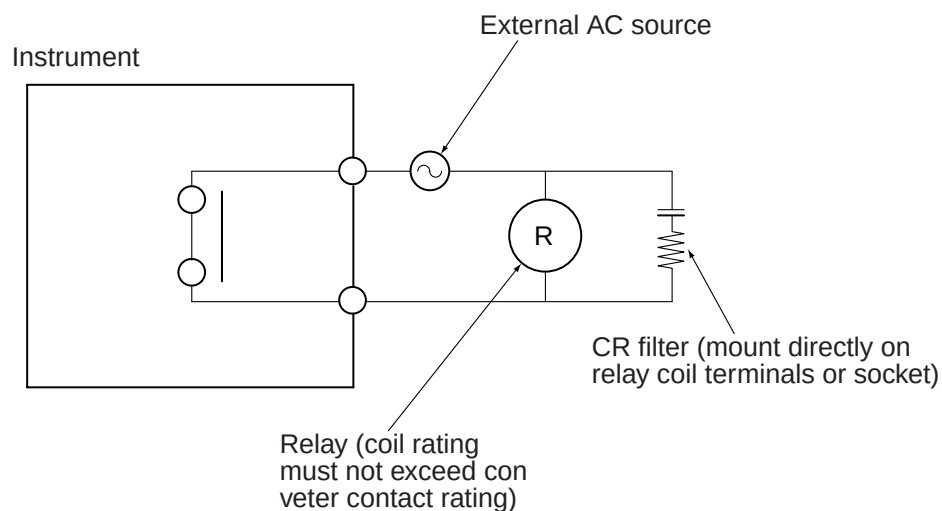
• For an DC relay



F3.7.EPS

Fig. 3.7

• For an AC relay



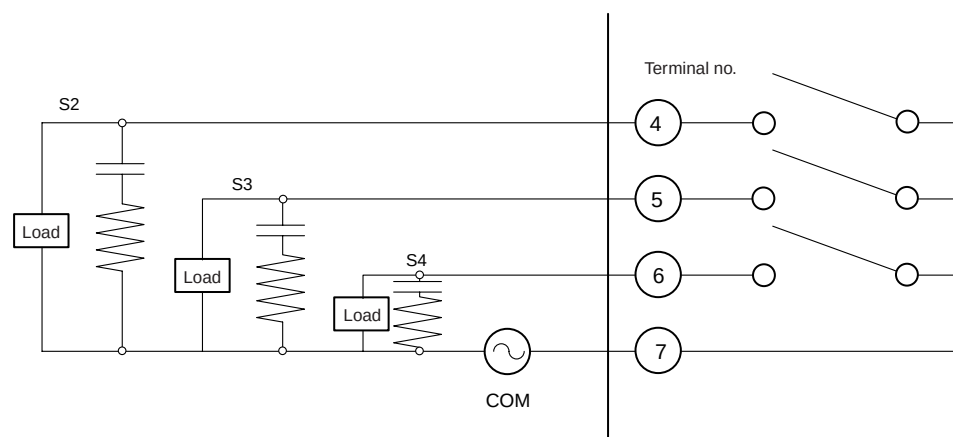
F3.8.EPS

Fig. 3.8

3.7.2 Wiring for S2 (for two-contact-output case) or S2, S3 and S4 (four-contact output case)

A terminal cover is fitted to reduce the risk of electric shock when power is applied. When connecting contact output wiring, you need to loosen the two cover screws to remove the cover. After completing the wiring, take care not to forget to replace the cover.

- (1) If you want to connect a load which exceeds the contact rating (voltage rating 240 V AC, current rating 3A resistive load, 30 VDC 3A resistive load) then you need to use a slave relay as shown in Sec. 3.7.1.
- (2) If switching a very small current, then -- if possible -- connecting a bleeder resistor in parallel with the relay (or the like) that is the load, can improve contact reliability.
- (3) If you connect an inductive load like a solenoid valve or slave relay then in parallel with the contacts you should connect a CR filter (when switching AC) or a diode (when switching DC), or contact life may be affected. Contact life is typically at least 10,000 switching operations with a resistive load.
- (4) Use the recommended terminals to terminate connecting cables, and make sure that they are the correct size to match the cable core diameter.



F3.9.EPS

Fig. 3.9

3.8 Power and Ground Wiring

- * Power: This wiring should connect a power source of the correct voltage and frequency to the EXA PH100 pH Converter. The power wiring should be heavy vinyl sheath cable rated at 600V (specifications equivalent to JIS C 3307).
- * Ground: Ground to earth (ground resistance 100 ohms or less). Use a sufficiently heavy cable (cross sectional area of 2 mm² or greater).
- * Use the recommended terminals to terminate connecting cables, and make sure that they are the correct size to match the cable core diameter.

A terminal cover is fitted to reduce the risk of electric shock when power is applied. When connecting contact output wiring, you need to loosen the two cover screws to remove the cover. After completing the wiring, take care not to forget to replace the cover.



WARNING

- * Be sure to disconnect power before removing the terminal cover. Since there is the danger of shock, turn off power and confirm that terminals are not live before wiring. Under no circumstances should terminals be touched when power is applied.
-

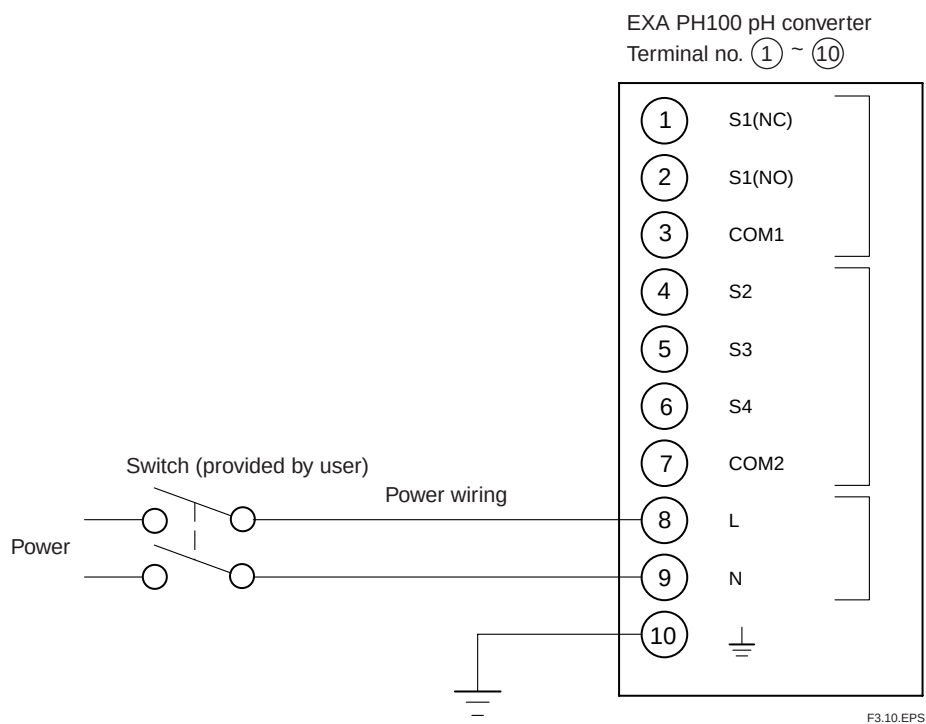


CAUTION

The EXA PH100 pH converter does not have a power switch built in. You should add an on-off switch with two poles (to disconnect both sides of the power line).

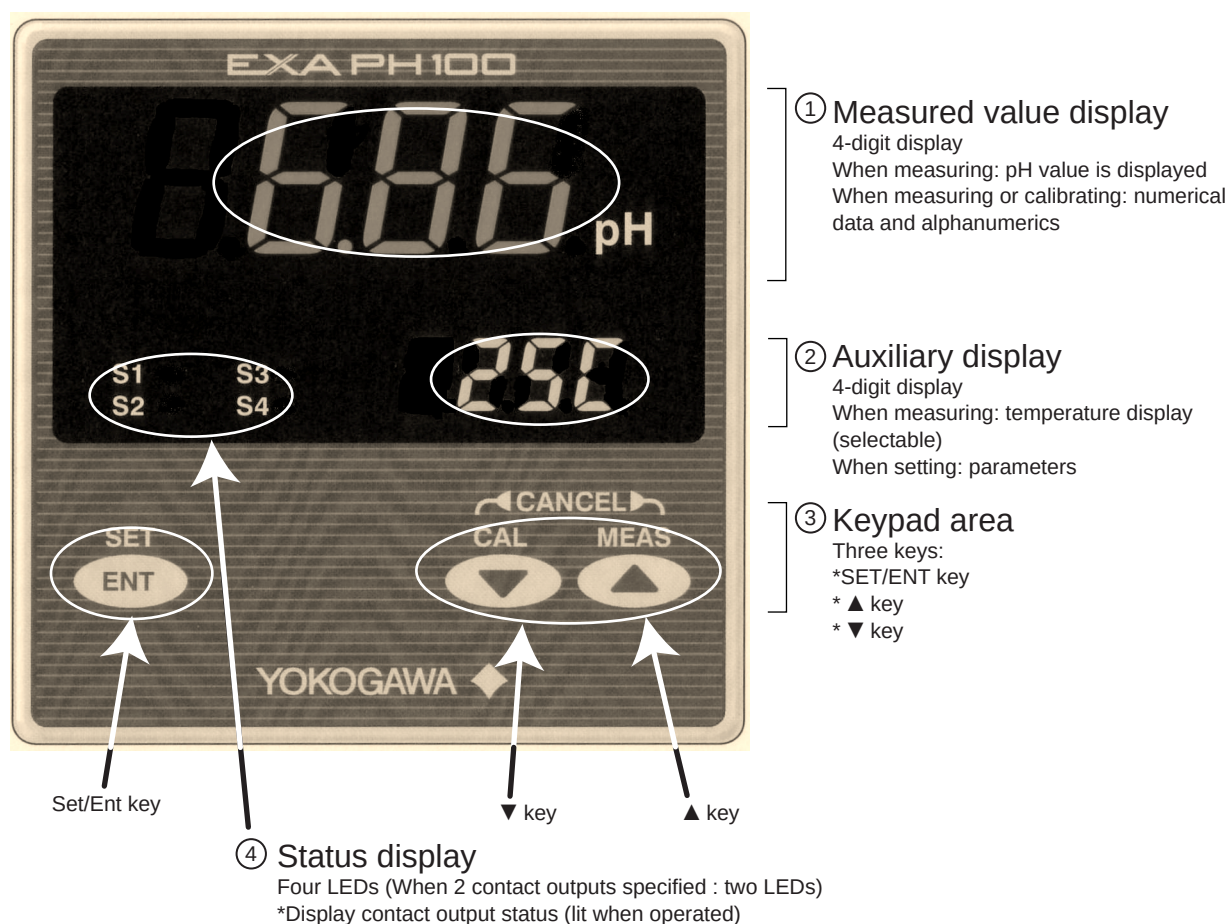
**WARNING**

Any errors in power and ground wiring may damage the converter. Before applying power to the converter, be sure to check the wiring.

**Fig. 3.10**

4. Overview of Operation Panel

4.1 Overviews of names and functions of operation panel keys

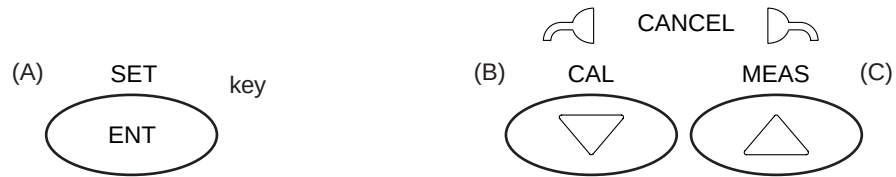


F4.1.EPS

Fig. 4.1

4.2 Key Operation

On the EXA PH100 front panel there are three keys for screen/mode switching and data entry.



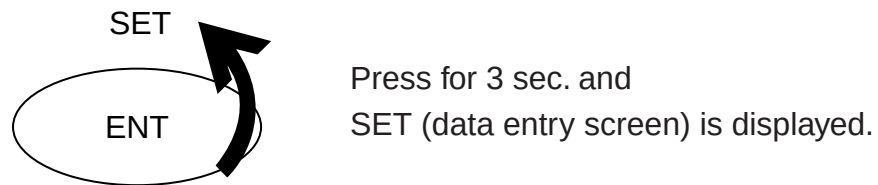
F4.2.EPF

Fig. 4.2 Layout of three keys on front panel

Main uses of these keys are as follows:

(A) SET/ENT key: used to confirm mode changes and data settings

* From the measurement panel, if you press it continuously for at least three seconds then the data setting screen is displayed.

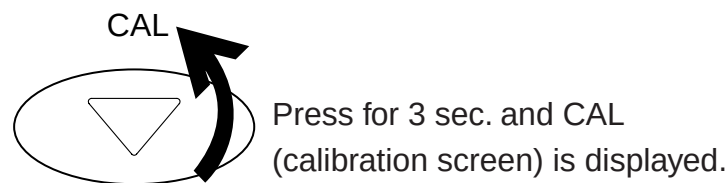


F4.3.EPS

Fig. 4.3

(B) (▼) key: Use to select different menu item or reduce data setting value.

* Pressing this key for at least three seconds switches to the calibration screen.

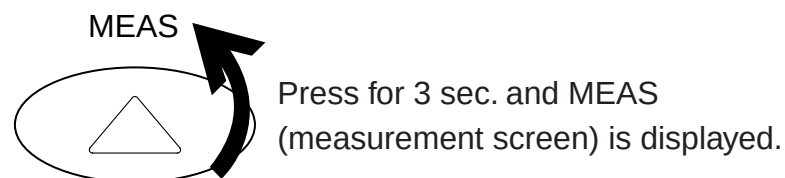


F4.4.EPS

Fig. 4.4

(C) (▲) key: Use to select different menu item or increase data setting value.

* Pressing this key for at least three seconds from calibration or data setting top screen switches back to the measurement screen.



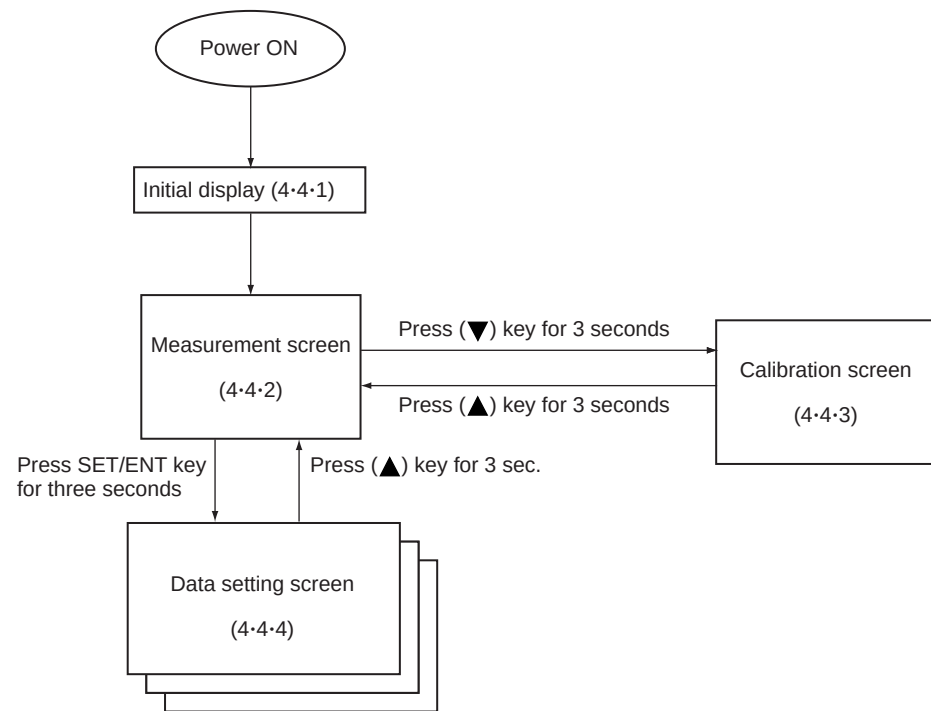
F4.5.EPS

Fig. 4.5

(B) + (C) Pressing both (▼) and (▲) screen simultaneously cancels operations

4.3 Switching display screens

EXA PH100 has three menu screens: measurement, calibration and data setting screens. The screen transition diagram is shown below.



F4.6.EPS

Fig. 4.6

4.4 Display screen examples

4.4.1 Initial display

Display when converter is normal.

(1) All LEDs are lit when converter is powered on.

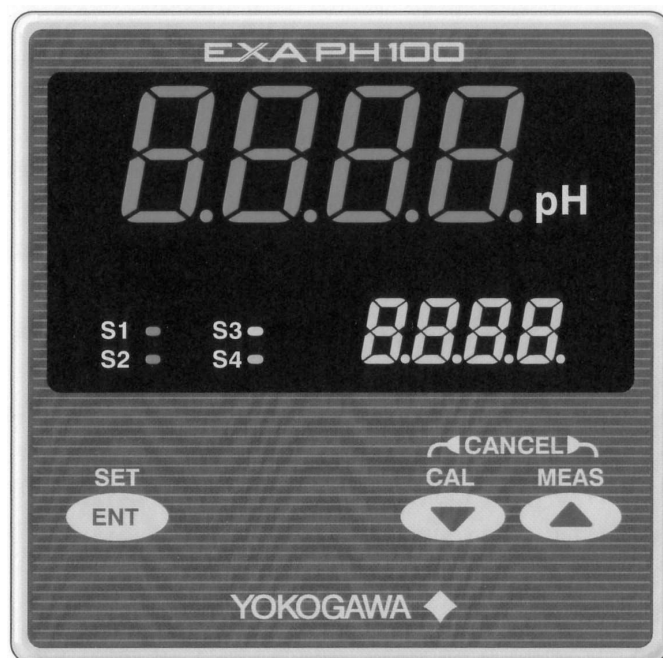


Fig. 4.7 All LEDs lit

(2) Then all LEDs turn off.

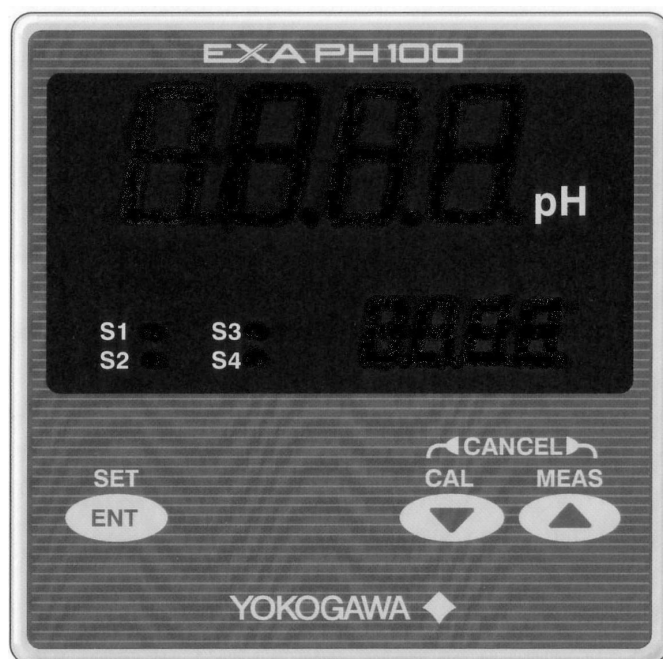


Fig. 4.8 All LEDs off

(3) Measurement screen is displayed

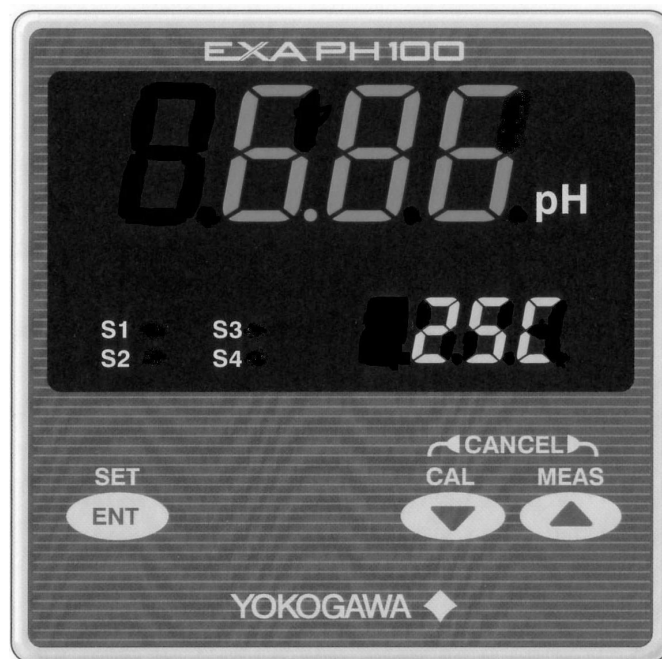


Fig. 4.9 Measurement screen with temperature display

4.4.2 Measurement screen

1) Measurement screen

* Measurement display: Displays pH value.

Decimal point is fixed; two digits below the decimal point.

* Auxiliary display:

When temperature display functions are provided, the temperature and units (C for °C, F for °F) are displayed. When temperature display functions are not provided, nothing is displayed. (The initial setting is for no temperature display).

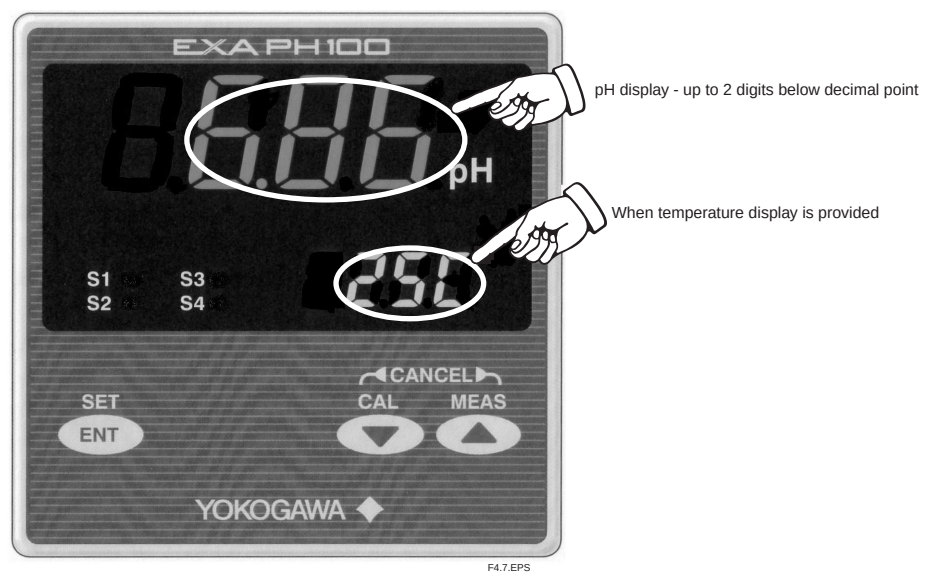
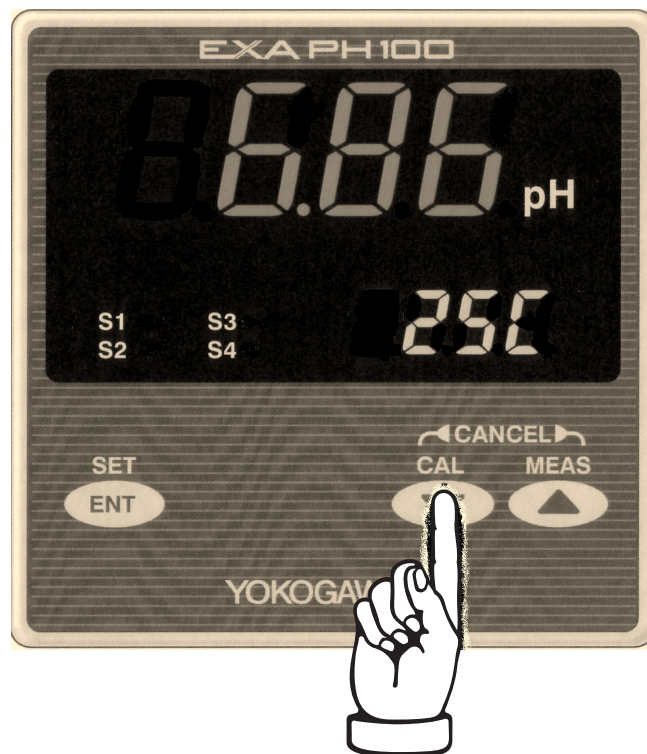


Fig. 4.10

4.4.3 Calibration screen

(1) From Measurement screen

Press (▼) key for 3 sec. to transfer to Calibration screen



Press for at less 3 sec.

Fig. 4.11 Measurement screen

(2) Calibration screen

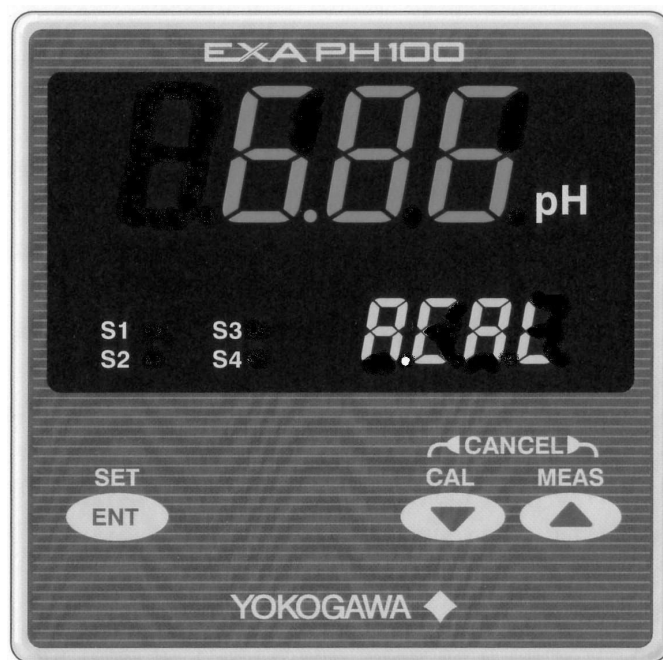


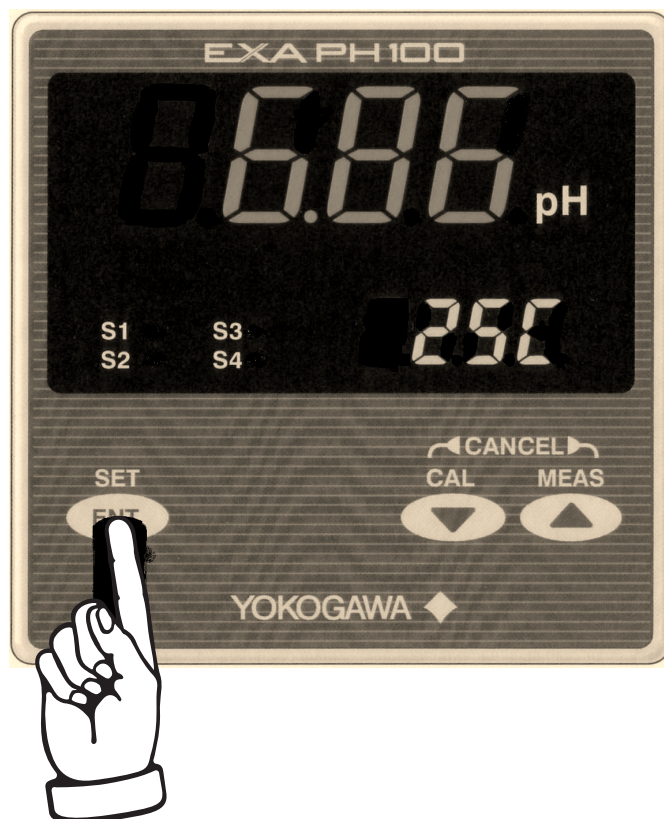
Fig. 4.12 Calibration screen (for Autocalibration case)

Press (▲) for at less 3 sec. to return to Measurement screen

4.4.4 Setting screen

(1) Measurement screen display

Press SET/ENT screen for at least 3 sec. to transfer to Setting screen.



Press for at less 3 sec.

Fig. 4.13 Measurement screen

(2) Setting screen

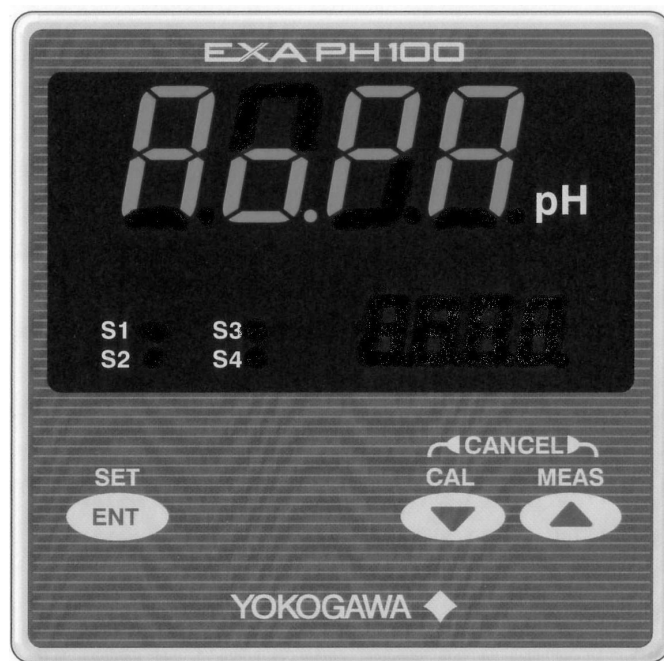


Fig. 4.14 Setting screen

Press (▲) for at less 3 sec. to return to Measurement screen

5. Operation

5.1 Start up

5.1.1 Check wiring

Check that all wiring is correct (refer to Sec. 3.3)

5.1.2 Start up pH converter

Apply power (100 to 240V AC $\pm$ 10% 50/60Hz) to EXA PH100 pH converter.

5.1.3 Data setting

Set the following parameters -- (1) analog output parameter, (2) calibration parameters, (3) alarm settings, and (4) other parameters -- in the order listed, to enable desired operation for process pH control:

(1) Analog output parameters

This screen is for user setting of analog-output-related settings

(2) Calibration parameters

This screen is for user setting of calibration-related settings

(3) Alarm parameters

This screen is for user setting of alarm-related settings

(4) Other parameters

This screen is for user setting of parameter settings other than (1) to (3) above.



Note

See Sec. 4 “Overview of Operation Manual” and table of LED display symbols in preface to this manual.

(1) Analog output parameter setting screen (Ao.PA displayed at top of screen)

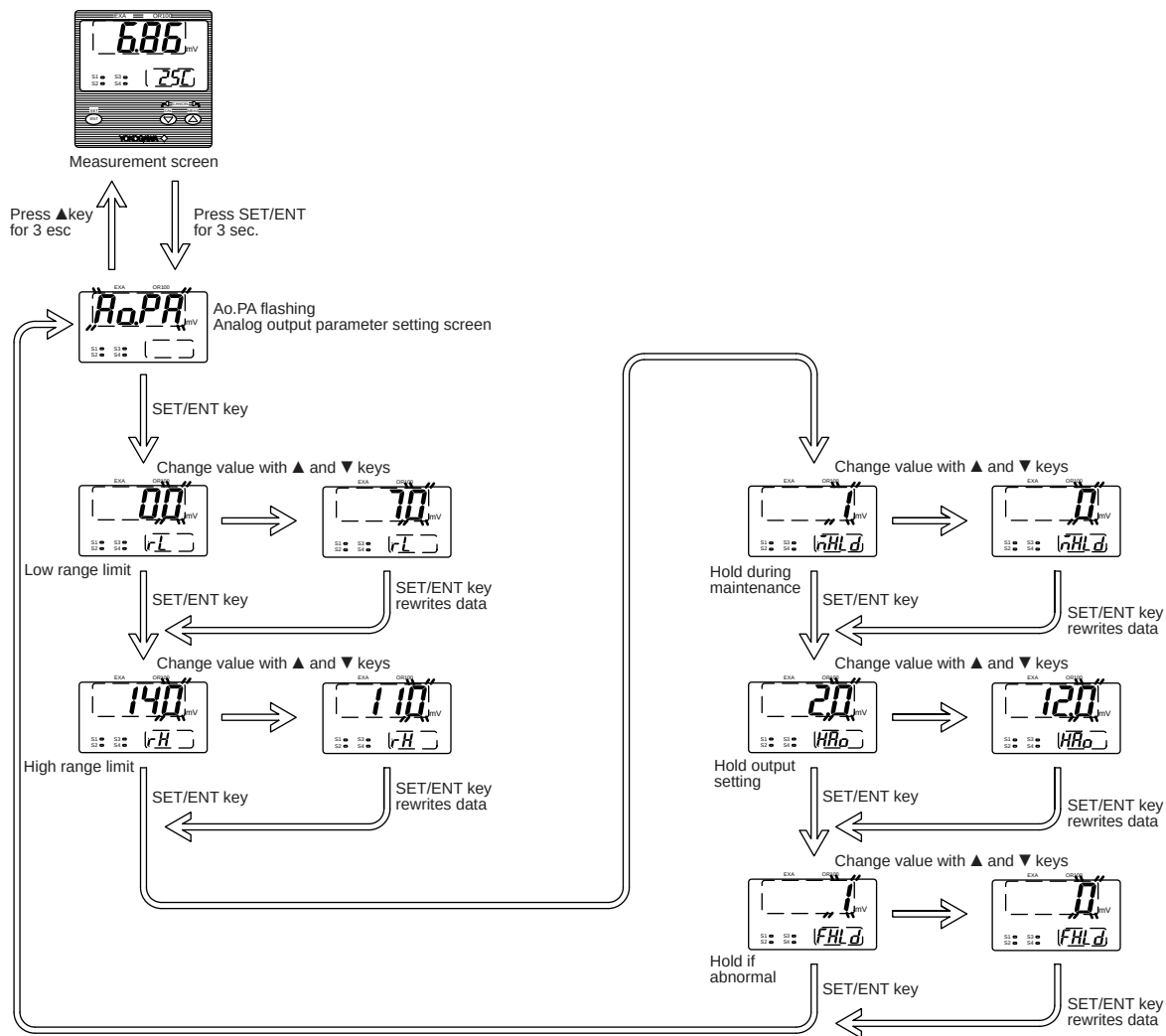
This screen is for user setting of analog-output-related settings. A list of menu options on this screen is shown below:

Table 5.1

Name	Parameter	Setting range	Initial value	Note
Ao.PA	Menu Title	NA (not applicable)	NA	
RL	Range low limit	−2.0 ~ 16.0pH	0.0pH	High & low at least pH2 apart
RH	Range high limit	−2.0 ~ 16.0pH	14.0pH	High & low at least pH2 apart
M.HLd	Hold during Maintenance	0 : No Hold 1 : Hold 2 : Set value	1 : Hold	
H.Ao	Hold output setting	2.0 ~ 20.8mA	2.0	
F.HLd	Hold if abnormal	0 : No Hold 1 : Burn out down scale (2mA)	1 : Burn out down scale (2mA)	

T5.1E.EPS

Example flow chart for analog output parameter setting is shown below



F5.1.EPS

Fig. 5.1 Example flow chart for analog output parameter setting

* Note: To cancel, press both (▼) and (▲) simultaneously.

(2) Calibration parameter setting screen (CAL displayed at top of screen)

This screen is for user setting of calibration-related settings. A list of menu options on this screen is shown below:

Table 5.2

Hame	Parameter	Setting range	Initial value	Note
CAL	Menu Title	NA (not applicable)	NA	
CL.md	Calibration method	0 : Autocalibration 1 : Manual calibration	0 : Autocalibration	
CL.Po	Calibration points	0 : One-point 1 : Two-point calibration	1 : Two-point calibration	
CL.2P	Two-point CAL std. liquid	0 : pH7, pH4 1 : pH9, pH7 (US: pH 10, pH7) 2 : pH9, pH4 (US: pH 10, pH4)	0 : pH7, pH4	
CL.1P	One-point CAL std. liquid	0 : pH7 1 : pH4 2 : pH9 (US: pH 10)	0 : pH7	
CL.tb	Std. liquid cal.table	0 : JIS, NIST 1 : US 2 : DIN	0 : JIS, NIST	

T5.2.EPS

Example flow chart for calibration parameter setting is shown below

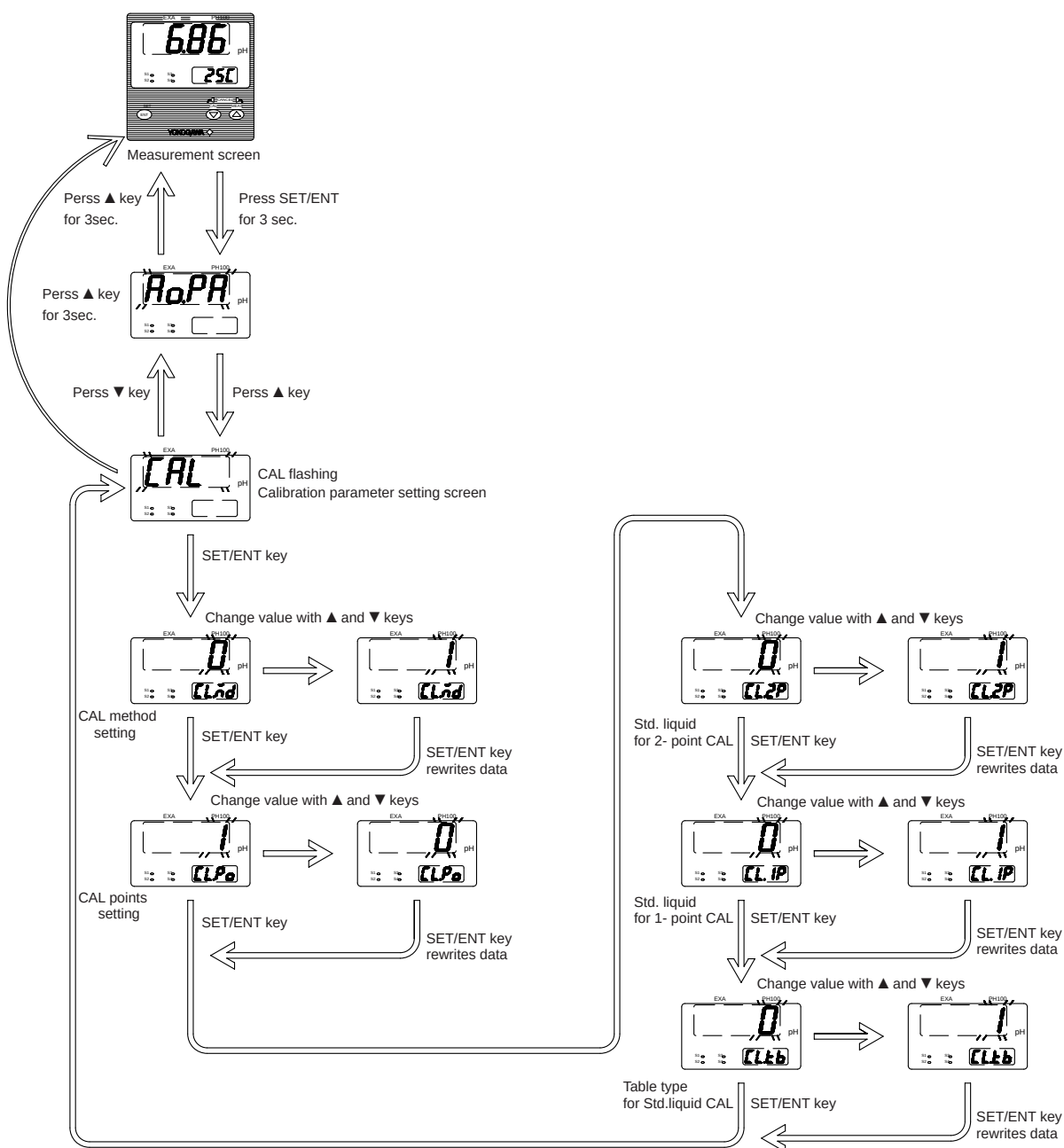


Fig. 5.2 Example flow chart for calibration parameter setting

* Note: To cancel, press both (▼) and (▲) simultaneously.

(3) Alarm parameter setting screen (Alrm displayed at top of screen)

This screen is for user setting of alarm data. A list of menu options on this screen is shown below:

Table 5.3

Hame	Parameter	Setting range	Initial value	Note
Alrm	top menu	NA (not applicable)	NA	
S1	S1	0: high limit alarm 1: low limit alarm 2: high high limit alarm 4: high high limit/low low limited alarm 5: abnormal	0: high limit alarm	
HY1	S1 hysteresis	0.0-4.0 pH	0.1 pH	
dLY1	S1 delay time	0-200 seconds	0	
S2	S2	0: high limit alarm 1: low limit alarm 2: high high limit alarm 4: high high limit/low low limited alarm 5: abnormal	1: low limit alarm	
HY2	S2 hysteresis	0.0-4.0 pH	0.1 pH	
dLY2	S2 delay time	0-200 seconds	0	
S3	S3	0: high limit alarm 1: low limit alarm 2: high high limit alarm 4: high high limit/low low limited alarm 5: abnormal	2: high high limit alarm	when suffix code is -21, S3 does not appear
HY3	S3 hysteresis	0.0-4.0 pH	0.1 pH	when suffix code is -21, HY3 does not appear
dLY3	S3 delay time	0-200 seconds	0	when suffix code is -21, dLY3 does not appear
S4	S4	0: high limit alarm 1: low limit alarm 2: high high limit alarm 3: low low limit alarm 4: high high limit/low low limited alarm 5: abnormal	3: low low limit alarm	when suffix code is -21, S4 does not appear
HY4	S4 hysteresis	0.0-4.0 pH	0.1 pH	when suffix code is -21, HY4 does not appear
dLY4	S4 delay time	0-200 seconds	0	when suffix code is -21, dLY4 does not appear
H.A	high limit alarm	-2.0-16.0pH	14.0pH	
L.A	low limit alarm	-2.0-16.0pH	0.0 pH	
HH.A	high high limit alarm	-2.0-16.0pH	14.0pH	
LL.A	low low limit alarm	-2.0-16.0pH	0.0 pH	

T5.3.EPS

Example flow chart for setting alarm parameters is shown below

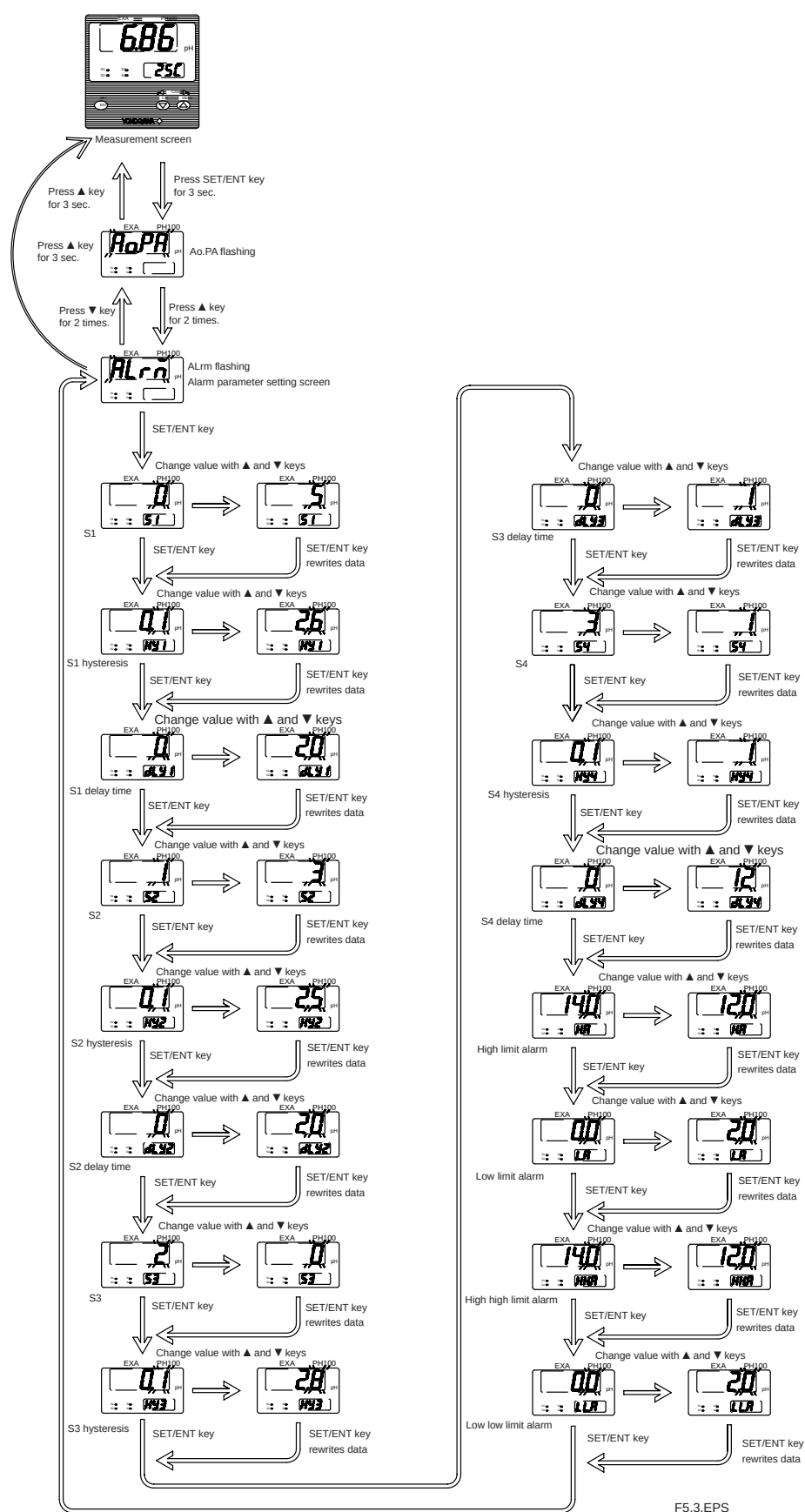


Fig. 5.3 Example flow chart for setting alarm parameters when four contacts output specified

Note: To cancel, press both (▼) and (▲) simultaneously.

(4) Other parameter setting screen (otHr displayed at top of screen)

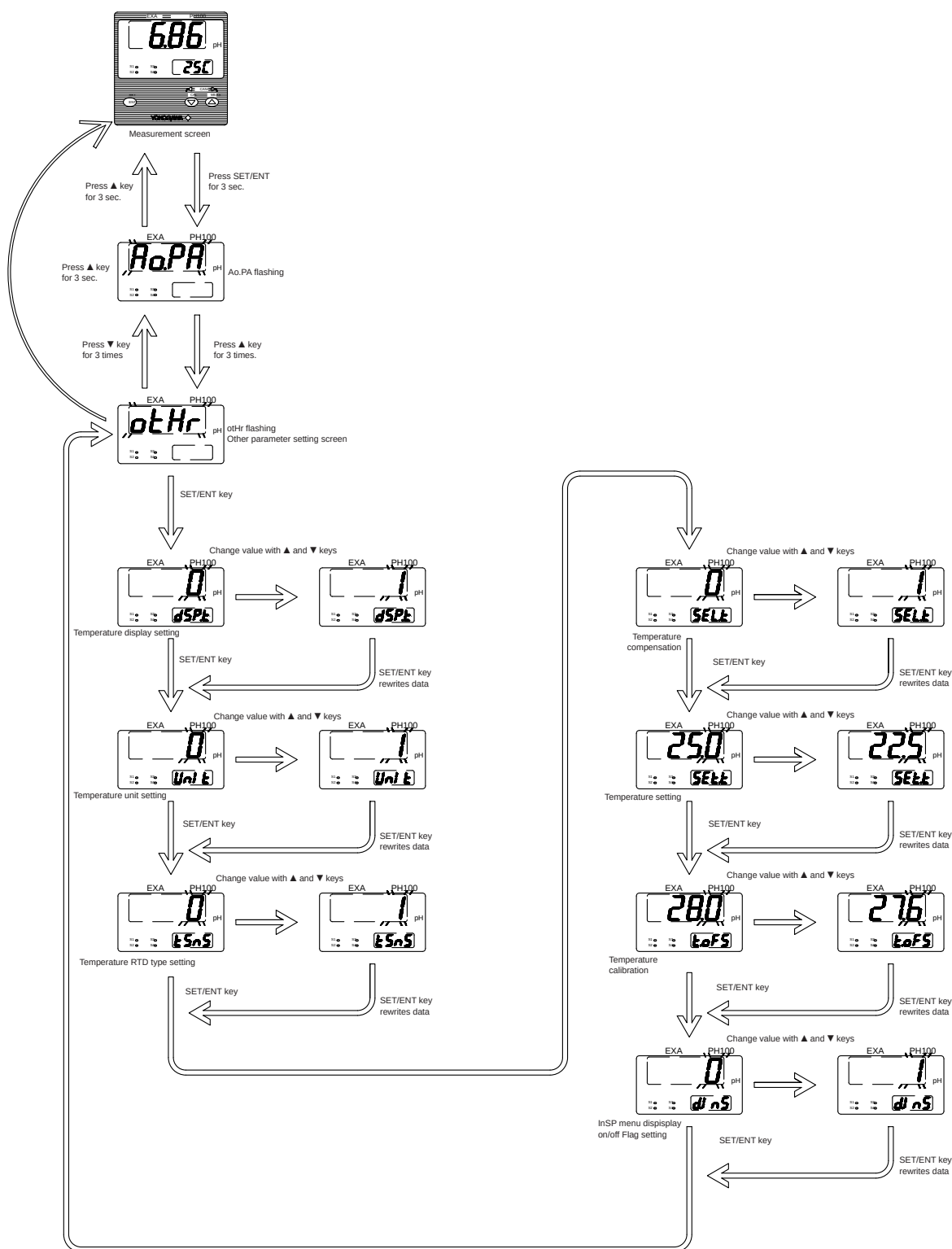
This screen is for user setting of parameters for other measurements. A list of menu options on this screen is shown below

Table 5.4

Name	Parameter	Setting range	Initial value	Note
otHr	Menu Title	NA (not applicable)	NA	
dsPt	temperature in display	0: OFF 1: ON	0: OFF	
UnIt	Temperature unit	0: °C 1: °F	0: °C	
t.SnS	RTD type	0: Pt1000 1: Other	0: Pt1000	Other depends on the suffix code
SEL.t	temperature compensation	0: automatic (temperature sensor) 1: manual (setting)	0: automatic (temperature sensor)	
SEt.t	temperature setting	-10.0~110.0°C (14.0~230.0°F)	25.0°C (77.0°F)	Effective when SEL.t is 1
t.CAl	temperature calibration (1-point calibration)	-15.0~115.0°C (5.0~239.0°F)	For reference. temperature is displayed when this parameter is displayed. The temperature is not updated automatically	Please input the actual temperature of the measurement liquid Effective when SEL.t is 0.
d.InS	InSP menu display fliag setting	0: no display 1: display	0: no display	Alwaus set 0 When the power is turned off, the setting become 0

T5.4.EPS

Example flow chart for setting other measurement parameters is shown below



F5.4.EPS

Fig. 5.4 Example flow chart for setting other measurement parameters

Note: To cancel, press both (▼) and (▲) simultaneously.

5.1.4 Temperature Calibration

The EXA PH100 PH converter is used with a pH sensor, and the resistance of the cabling between them will vary depending on the length of the cable. When Yokogawa's PH10FP or PH10RP are used, the cable length is selectable – it may be any of 3 m, 5 m, or 10 m. When the WTB100 intermediate terminal box is used with the special WF100 extension cable, the cable length may be increased up to 50 m. For accurate temperature compensation, one time temperature calibration (to compensate for the resistance of the cable between converter and detector) after installation is recommended.

Procedure for Temperature Compensation

Temperature compensation should be performed with the measured solution as near as possible to the normal temperature of measurement. To minimize temperature change during measurement, you should prepare at least 4 liters of solution. You also need a thermometer to measure the temperature of the solution. Temperature calibration uses the t.CL (Temperature Calibration) setting screen described in Section 5.1.3 (4) Other Parameters.

The pH detector (immersed up to the liquid junction) and thermometer should be placed in the solution to be used for temperature calibration. For best accuracy, leave the detector until its temperature has stabilized (this usually takes about two minutes) before reading the thermometer, setting that temperature into the conductivity converter, and calibrating.

Temperature calibration can be performed in the range -15°C to +115°C, and the compensation value (pH detector measured temperature minus thermometer measured temperature) should be within the range -20°C to +5°C.

5.1.5 Calibration with Standard Liquid

The emf of the glass electrode varies a little between electrodes. Before starting normal operation, calibrate with standard solution.

The emf of the electrode will also vary if it gets dirty or as the electrode ages, so recalibration needs to be performed periodically at frequent enough intervals to keep error within rated tolerance.

The procedure for calibration with standard liquid is described in Sec. 6.

5.2 Test Operation

To check if operation of the EXA PH100 pH converter is normal, monitor it in test operation mode for a while.

5.3 Normal operation

From the parameter setting screen, press the (▲) key for at least 3 seconds to return to the measurement screen.

Apart from when changing settings or calibrating with standard solution, during normal operation there should be no need for operating this machine.

If an error message is displayed or the output scales out, refer to Sec. 8 for troubleshooting. please make the cause be clear by following the on and treat immediately.

Also, please be sure to perform the daily checks and maintenance described in Sec. 7 in order to maintain reliable operation.

5.4 Stopping and Restarting Operation

After changing settings, be sure to wait at least 2 seconds before turning off the power. In other cases, no special precautions are required.

To stop operation, simply turn off the power supply.

To restart operation, simply restore power and parameter values remain the same as before the power failed.

6. Calibration with standard solution

The emf characteristics of pH electrodes vary between electrodes, and vary with electrode aging. The variability of pH detectors that are used only for short periods can be particularly high. The variability of pH detectors that are used only occasionally for short periods can be particularly high. So there is a need for electronic circuitry to perform automatic compensation of pH.

Calibration with standard solution involves measuring the pH of standard solution of known pH, and adjusting the pH meter to show the correct pH value.

Calibration with standard solution of the EXA PH100 pH converter can be either automatic calibration using standard solutions of two predetermined pH values chosen from pH 4, 7, and 9 (JIS), and manual calibration using arbitrary standard solution.

6.1 Important issues relating to calibration with standard solution

- (1) Be careful to use the standard solution marked with the correct pH.
If the pH standard solution has deteriorated and its pH changed, calibration will not be accurate.
Note: when automatic calibration is used, choose two standard solutions from those (pH4, pH7 and pH9) shown in Table 6.1.
- (2) If the temperature of the standard solution is changing, the measured pH value will not stabilize. At calibration time, keep the standard solution at constant temperature.
- (3) During auto calibration, do not touch ENT or (▲), (▼) keys as calibration values may be affected.

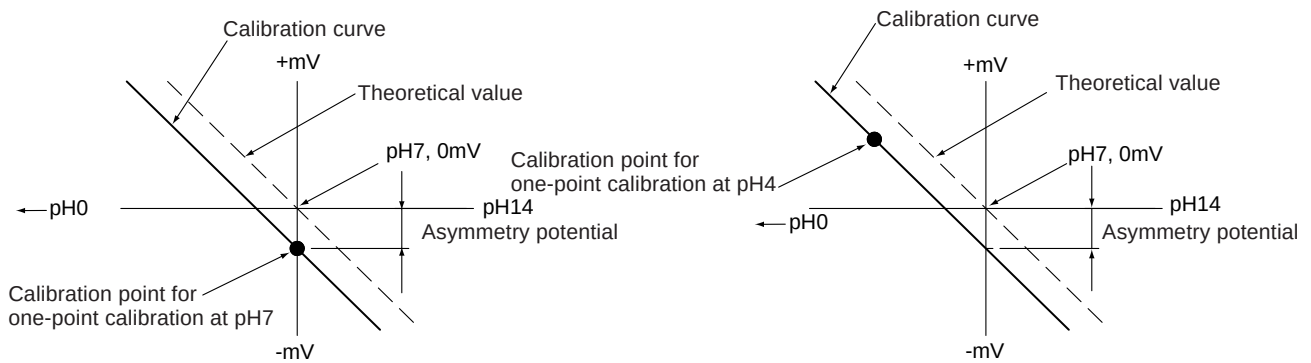
Table 6.1 JIS Z8802 standard solution

Standard solution/ temperature °C	0	5	10	15	20	25	30	35	40	45	50	55	60	70	80	90	95
pH4	4.01	4.01	4.00	4.00	4.00	4.01	4.01	4.02	4.03	4.04	4.06	4.08	4.10	4.12	4.16	4.20	4.23
pH7	6.98	6.95	6.92	6.90	6.88	6.86	6.85	6.84	6.84	6.83	6.83	6.84	6.84	6.85	6.86	6.88	6.89
pH9	9.46	9.39	9.33	9.27	9.22	9.18	9.14	9.10	9.07	9.04	9.01	8.99	8.96	8.93	8.89	8.85	8.83

T6.1.EPS

6.2 Calculations involved in Calibration with Standard Solution

- (1) When performing auto one-point calibration of the EXA PH100 pH converter using one type of standard solution, use one of the standard solutions (pH4, pH7 or pH9) and adjust the asymmetry potential so that the calibration curve passes through the calibration point (see Fig. 6.1).



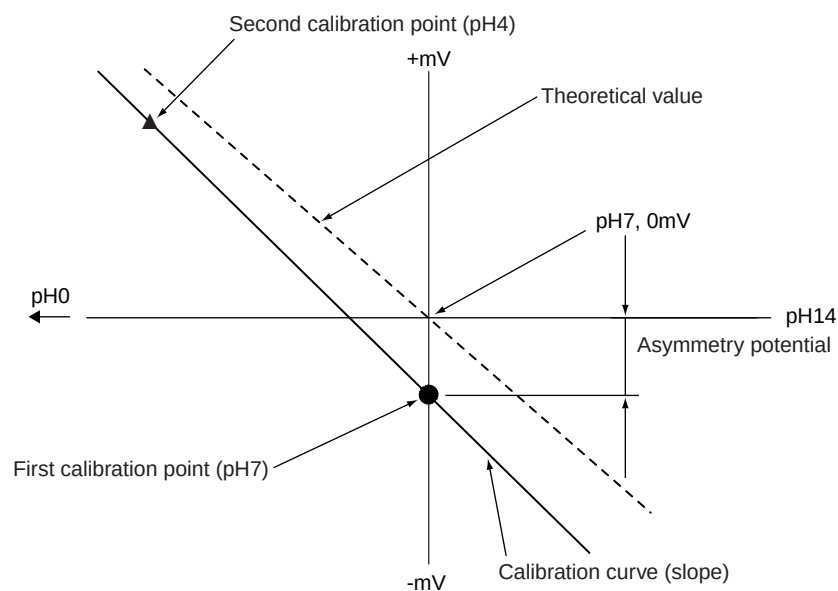
F6.1.EPS

Fig. 6.1

*) When you measure the pH of solutions that have nearly the same pH as a standard solution, you can use auto one-point calibration, a simple method of calibration that gives sufficient accuracy in this case.

- 2) When using two kinds of standard solution for two-point automatic calibration of the EXA PH100 pH converter, choose two standard solutions pH4, pH7 or pH9 and adjust the asymmetry potential and slope so that the calibration curve passes through the first and second calibration points (Fig. 6.2)

Second calibration point (pH4)



F6.2.EPS

Fig. 6.2

- 3) When using one kind of standard solution for manual calibration of the EXA PH100 pH converter, choose any of the standard solutions and draw the calibration curve through the calibration point (Fig. 6.3).

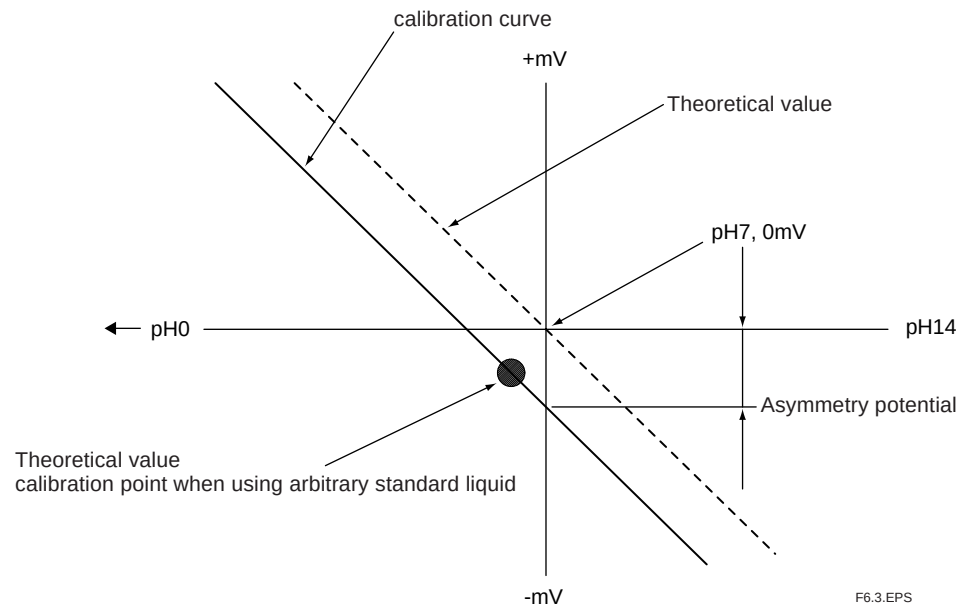


Fig. 6.3



CAUTION

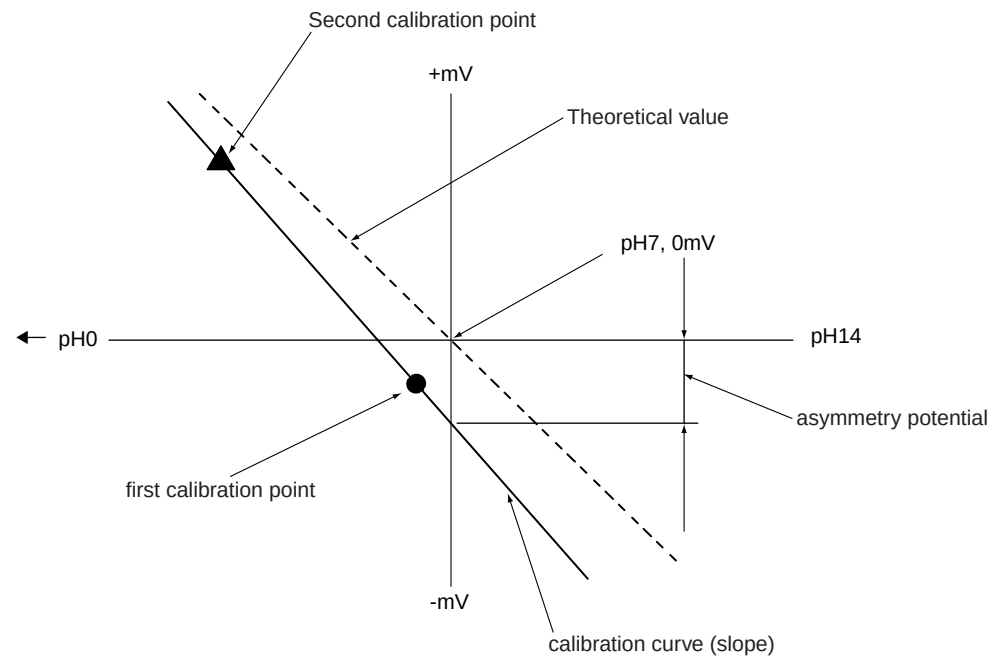
Calibration point represents the electrode emf corresponding to the pH value of the standard solution used.

- 4) When using two kinds of standard solution for manual calibration of the EXA PH100 pH converter, choose two arbitrary standard solutions and adjust the asymmetry potential and slope so that the calibration chart passes through the first and second calibration points (Fig. 6.4)



CAUTION

It will need more than a pH difference of at least 2 between pH values of the two kinds of standard solution.



F6.4.eps

Fig. 6.4

6.3 Preparation

(1) Selection the calibration method

* On the calibration parameter setting screen, select the calibration method: automatic calibration or manual calibration.

* On the calibration parameter setting screen, select one-point calibration or two-point calibration. Usually, we recommend two-point calibration.

1) Two-point calibration

Select combination of standard solutions from the following:

* pH7 and pH4

pH9 (pH10*) and pH7

pH9 (pH10*) and pH4

*: if US technical standard solution table selected.

2) One-point calibration

Select standard solution from the following:

pH7

pH4

pH9 (pH10*)

*: if US technical standard solution table selected

* On the calibration parameter setting screen, select the kind of standard solution calibration table from JIS • NIST standard solution table, US technical standard table, or DIN standard solution table.

Example flow chart for setting of auto calibration (two-point calibration) at pH9 and pH7, using JIS standard calibration table.

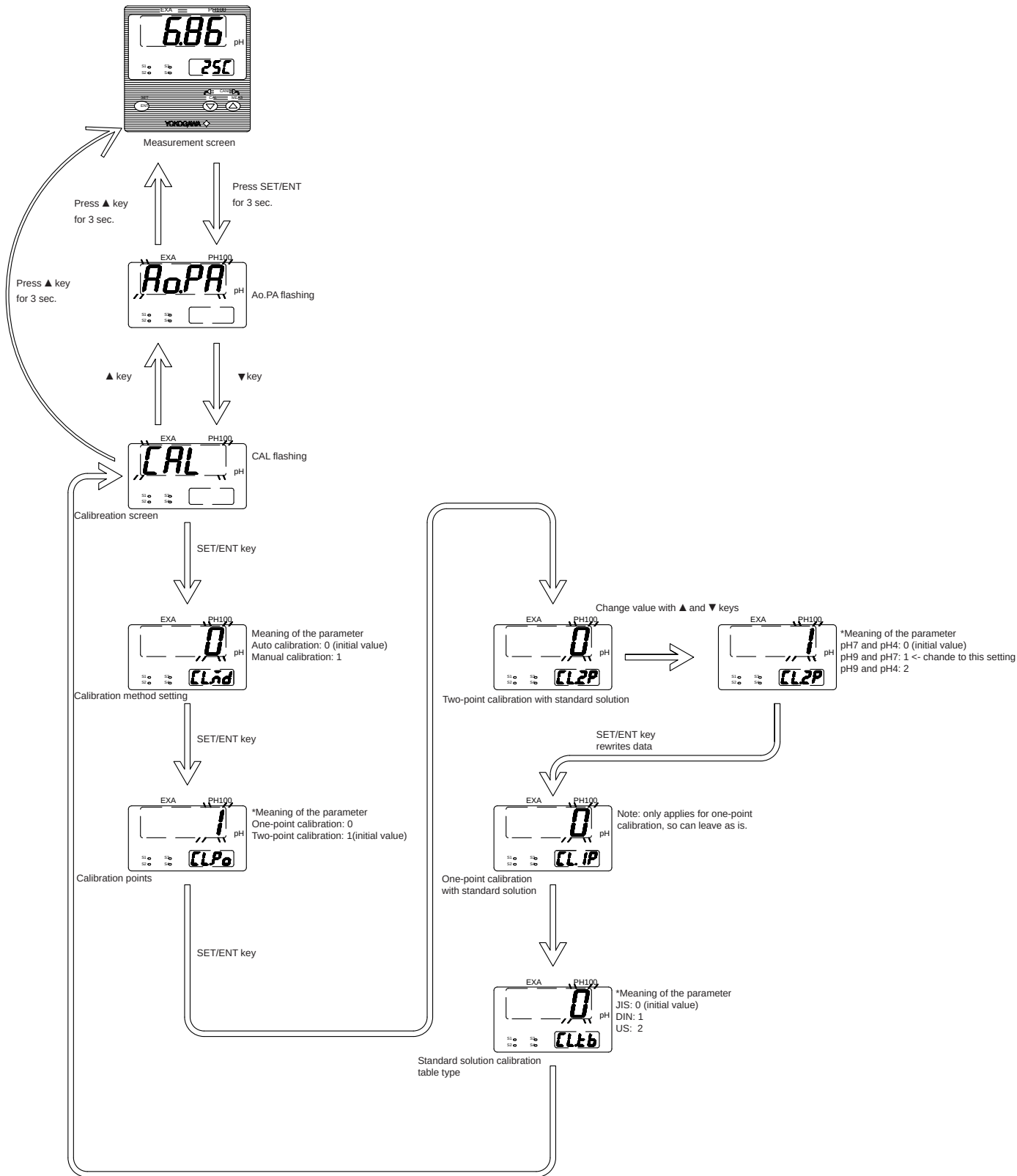


Fig. 6.5

(2) Preparation for auto calibration

- * For two-point calibration, select two types of standard solution from among pH4, pH7 and pH9.



CAUTION

In the US, select two from among pH4, pH7, and pH10.

- * For one point calibration, select one type of standard solution from among pH4, pH7 and pH9.



CAUTION

In the US, select one from among pH4, pH7, and pH10.

- * Prepare two clean containers of size about 200ml, and water (e.g. pure water) for washing the pH electrode.

(3) Preparation for manual calibration

- * For two-point calibration, select any two of the pH standard solutions. But the two selected need to differ in pH by at least pH2.
- * For one-point calibration, use any one of the pH standard solutions.
Prepare two clean containers of size about 200ml, and water (e.g. pure water) for washing the pH electrode.



CAUTION

When manual temperature compensation is to be performed, provide a thermometer for measuring the temperature of the standard solutions.

6.4 Auto calibration with standard solution

6.4.1 Setting parameters for auto calibration

Set parameter for auto calibration as per Fig. 5.2, before starting auto calibration.

6.4.2 Procedure for auto calibration

This section describes, as an example, two-point auto calibration using standard liquids of pH7 and pH4.

- 1) On the measurement screen, press (▼) key for 3 seconds to switch to the auto calibration screen.

Measured value display shows current measured value. For example: "6.86"

Auxiliary display shows "A.CAL".

- 2) Wash the pH electrode thoroughly with pure water.
- 3) Dip the detector head in the first standard solution.
- 4) Press SET/ENT key.

Auxiliary display: displays types of standard solutions that are set at present, e.g. "4-7".

- 5) Press SET/ENT key. The auxiliary display will show "CAL7" blinking quickly. (meaning "beginning pH7 calibration).

*note: you can select the other standard solution first (e.g.: CAL4) by pressing (▲) key, then second solution will be pH7.

- 6) press SET/ENT key after selecting the standard solution pH to be measured.

- 7) if "temperature compensation" setting is "manual" then manually measure and set the measured temperature of the standard solution.

The measurement display shows measured temperature. The auxiliary display shows "25C" (1°C unit), and the least significant digit blinks. For manual temperature compensation, set the temperature on the auxiliary display with (▲) and (▼) keys.

- 8) When you press the SET/ENT key, the measurement display value blinks. The auxiliary display shows "CAL7".

- 9) The converter waits until the measured electrode emf, representing the pH value, stabilizes, performs temperature compensation and calibrates the first pH value.

The blinking of the measurement display value stops.

"Ent7" is displayed, blinking, in the auxiliary display.

*Note: if you want to repeat calibration with the same standard solution, press (▲) and (▼) keys at the same time (for "cancel").

- 10) Press SET/ENT key.

The results of calibration at the first calibration point are displayed.

*Note: until you have finished the calibration (both points, in this case), calibration results are not reflected in any measurement values.

- 11) Auxiliary display shows "CAL4", blinking. (meaning "start pH4 calibration")

PH value of standard solution to be calibrated will be display due to setted parameter.

- 12) wash the pH electrode thoroughly with pure water and dip the detector into the second standard solution.

- 13) Press SET/ENT key

For manual temperature compensation (manually set temperature), set the temperature of the standard solution.

Measured value display shows the measured value.

Auxiliary display shows the temperature (in 1°C units) used for first calibration point, with the least significant digit blinking.

- 14) Use (▲) and (▼) keys to set the temperature on the auxiliary display.

- 15) Pressing SET/ENT key causes the measurement value on the measurement to blink. The Auxiliary display shows "CAL4".

- 16) The converter waits until the measured electrode emf, representing the pH value, stabilizes, performs temperature compensation and calibrates the first pH value. Measurement value on measurement display stops blinking.
“Ent4” blinks on Auxiliary display.
- Note: if you want to repeat calibration with the same standard solution, press (▲) and (▼) keys at the same time (for “cancel”).
- 17) Press SET/ENT again to start the calibration calculation.
If the calibration results are normal, the auxiliary display shows “Good” (blinking).
If results are abnormal, the auxiliary display shows an error code.
- 18) Pressing SET/ENT key again reverts to original “ACAL” display. If data is abnormal then the calibration data is updated.
- 19) To revert the detector to online measurement of the process, press (▲) key for at least 3 seconds, and the measurement screen reappears.

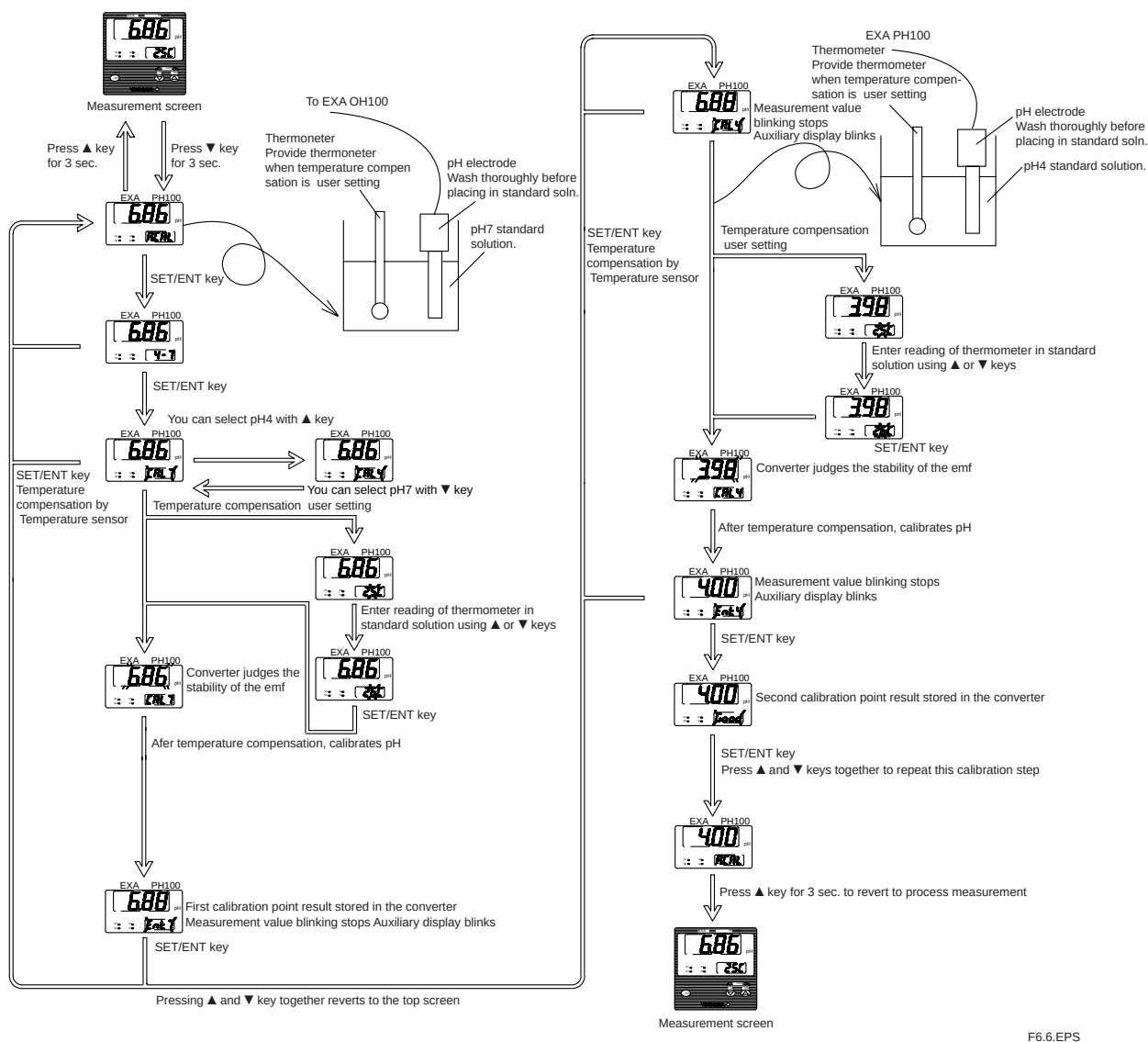


Fig. 6.6 Two-point auto calibration using standard solution of pH7 and pH4

Here we describe an example of one-point auto calibration method using a standard solution of pH7

- 1) On the Measurement screen, press the (▼) key for three seconds to switch to the autocalibration screen. The current measurement value is displayed, for example 6.86
The Auxiliary display changes to “A.CAL”
 - 2) Clean the pH electrode with an adequate amount of pure water.
 - 3) Dip the sensor in standard solution.
 - 4) Press the SET/ENT key. The Auxiliary display shows pH of the standard liquid to be used for calibration, e.g. “7”.
 - 5) Press the SET/ENT key. The Auxiliary display shows “CAL7” blinking, meaning “started pH 7 calibration”.
 - 6) Check that the correct standard solution is being used, then press the SET/ENT key. The measured pH value is displayed, and if temperature compensation is set to Manual (user entry) you then need to set the standard solution temperature: the Auxiliary display shows 25°C with the 5 blinking; you can change this setting using the (▲ ▼) keys.
 - 7) Press the SET/ENT key, and the measured value is displayed, flashing. The Auxiliary display shows “CAL7”.
 - 8) The converter waits until the measured electrode emf, representing the pH value, stabilizes, performs temperature compensation and calibrates the first pH value. The blinking of the measurement display value stops.
“Ent7” is displayed, blinking, in the auxiliary display.
- *Note: if you want to repeat calibration with the same standard solution, press (▲) and (▼) keys at the same time (for “cancel”).
- 9) Press the SET/ENT key again. The calibration (correction) calculation is performed; if normal, then “Good” is displayed, blinking, on the Auxiliary display. If there is any abnormality, then an error code is displayed. For details of the meaning of error codes, see Sec. 8.2.
 - 10) Press the SET/ENT key again to update the calibration data. (If there is any abnormality, the data won’t be updated).
 - 11) To return the sensor to online process measurement, press the (▲) key for at least 3 sec. to return to the measurement screen.

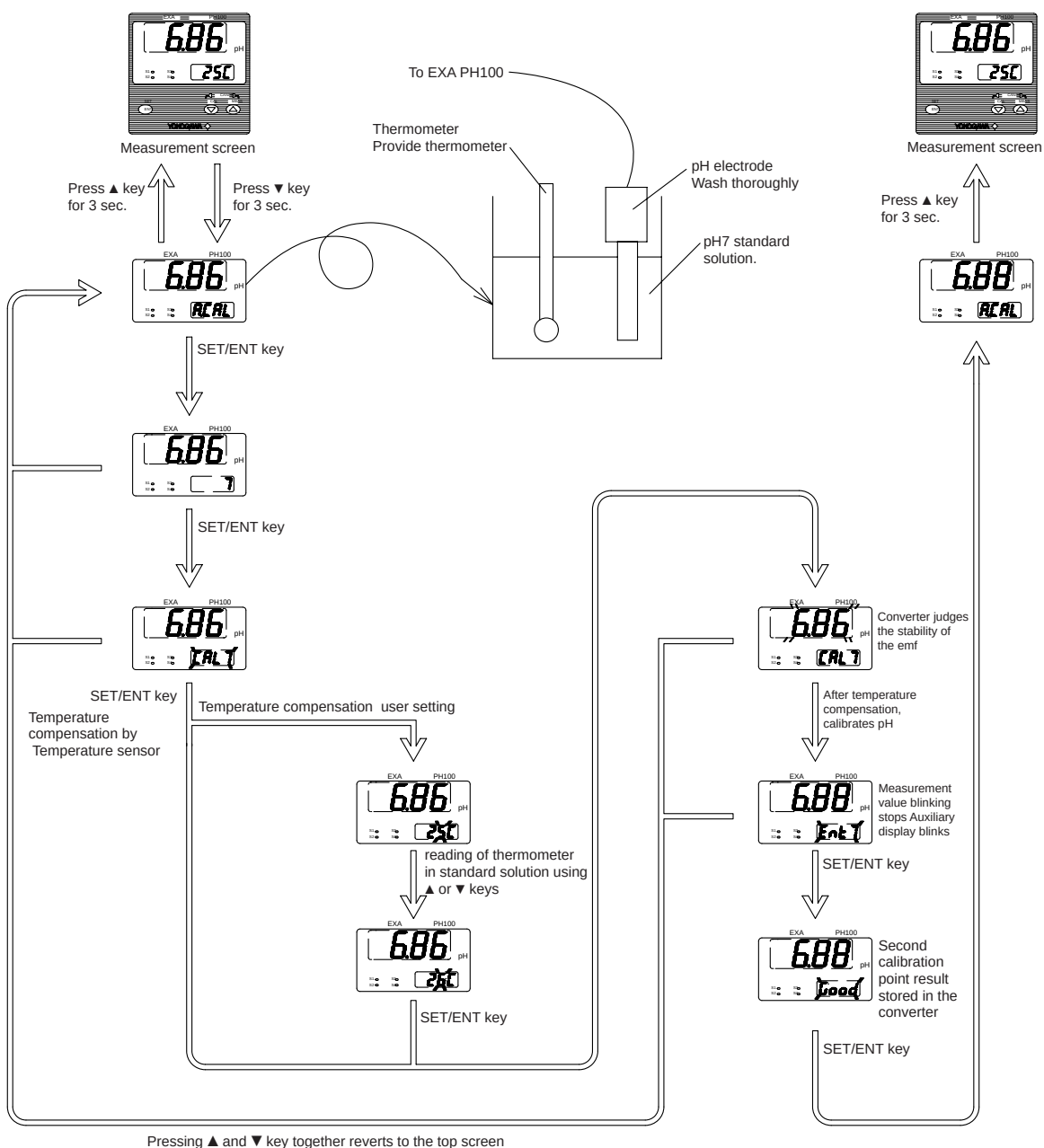


Fig. 6.7 One-point auto calibration using standard solution pH7

6.5 Manual Calibration with Standard Solution

6.5.1 Manual Calibration Parameter Settings

Before starting calibration, set the parameters relating to manual calibration.

6.5.2 Procedure for Manual Calibration

- 1) On the measurement screen, press (▼) key for 3 seconds to switch to manual calibration screen
“M.CAL” is shown on the auxiliary display
- 2) Wash the pH electrode in pure water
- 3) Dip the detector in the standard solution (arbitrarily-selected) for the first calibration point.
- 4) Press SET/ENT key
“CAL1” on the auxiliary display blinks.
(meaning “beginning first point calibration”)
- 5) Press SET/ENT key. If temperature compensation is set to Manual (user entry) you then need to set the standard solution temperature: the Auxiliary display shows 25°C with the 5 blinking; you can change this setting using the (▲ ▼) keys.
- 6) Press the SET/ENT key, and the measured value is displayed, flashing. The Auxiliary display shows “CAL1”.
- 7) Wait for the reading to stabilize, then press the SET/ENT key. The first digit of the measured value blinks, and the Auxiliary display shows the temperature.
- 8) Press the (▲ ▼) keys to adjust the displayed pH to the value after temperature compensation.
- 9) Press the SET/ENT key again to update the calibration data. The measured value blinking stops, and the Auxiliary display shows “Ent1” blinking.
Note: To repeat the measurement and calibration at this point, press (▲ ▼) keys simultaneously.
- 10) Press SET/ENT key.
The results of calibration at the first calibration point are displayed.
*Note: until you have finished the calibration (both points, in this case), calibration results are not reflected in any measurement values.
Auxiliary display shows “CAL2”, blinking (meaning “start 2nd point calibration”)
The (measured) pH of the standard solution is displayed.
- 11) Wash the pH electrode thoroughly with pure water and dip the detector into the second standard solution.
- 12) Arbitrarily select the standard solution to be used for 2nd point calibration.
- 13) Press SET/ENT key
For manual temperature compensation (manually set temperature), set the temperature of the standard solution.
Measured value display shows the measured value.
Auxiliary display shows the temperature (in 1°C units) used for first calibration point, with the least significant digit blinking.
- 14) Use (▲ ▼) keys to set the temperature on the auxiliary display.
- 15) Pressing SET/ENT key causes the measurement value on the measurement to blink.
The Auxiliary display shows “CAL2”.
- 16) Waits for the measured pH value to stabilize, then press the SET/ENT key. The first digit of the measured value blinks, and the Auxiliary display shows the temperature.
- 17) Press the (▲ ▼) keys to adjust the displayed pH to the value after temperature compensation.

- 18) Press the SET/ENT key again to update the calibration data. The measured value blinking stops, and the Auxiliary display shows “Ent2” blinking.

Note: To repeat the measurement and calibration at this point, press (▲ ▼) keys simultaneously.

- 19) Press SET/ENT key.

If calibration results were normal, then “Good” (blinking) is displayed on the Auxiliary display. If results are abnormal, the auxiliary display shows an error code. For details of the meaning of error codes, see Sec. 8.2.

- 20) Press the SET/ENT key again to update the calibration data. The “M.CAL” display in 1) above reappears. If data is abnormal then the calibration data is not updated.

- 21) To revert the detector to online measurement of the process, press (▲) key for at least 3 seconds, and the measurement screen reappears.

6.6 Canceling Calibration

To cancel calibration

- 1) Press (▲ ▼) keys simultaneously several times until you revert to the top calibration screen (Auxiliary display shows A.CAL or M. CAL).
- 2) To revert to measurement of the process, press (▲) key for at least 3 sec. to revert to the measurement screen.

6.7 Error during Calibration

If slope is outside the range 70% to 110% or asymmetry potential is outside the range -120 mV to 120 mV then a calibration error results. The measured display is displayed but the Auxiliary display shows a blinking error code. No updating is performed in the case of such an error. For details of error codes, refer to Sec. 8.2.



CAUTION

If an error occurs, the only key entry that is accepted on either Autocalibration screen or Manual calibration screen is to press (▲ ▼) keys simultaneously to abort calibration.

6.7.1 Recovering from an Error

To repeat calibration:

- 1) Press (▲ ▼) keys simultaneously several times to revert to top calibration screen.
- 2) Press SET/ENT key and repeat calibration procedure from beginning.

6.7.2 Quitting calibration

- 1) Press (▲ ▼) keys simultaneously several times to revert to top calibration screen.
- 2) Press (▲) key for at least 3 sec. to revert to Measurement mode.



CAUTION

Replace the sensor in the process before operate keys.

7. Maintenance and Cleaning

7.1 Periodic Maintenance

7.1.1 Electrode cleaning

When the glass electrode and liquid junction of the pH sensor become dirty, the measured value may become unstable or drift and response may become very slow. Clean the electrode periodically,



CAUTION

For details of the procedure for washing the pH electrode, refer to the instruction manual for the sensor you are using.

7.1.2 Calibration with Standard Liquid

The emf of a sensor electrode changes as the electrode ages. Dirt adhering to the electrode will also affect the electrode emf. Since this will otherwise cause measurement errors, you should recalibrate the sensor periodically. You might start by calibrating it weekly and recording the data, and using this data as a basis for determining the optimum calibration interval. Refer to Sec. 6 for the calibration procedure.

7.1.3 Checking the KCl in the Detector

If you use a refillable sensor, you should periodically top up the KCl.



CAUTION

For the procedure for topping up the sensor, refer to the instruction manual for the sensor you are using.

7.2 Preventative Maintenance

7.2.1 PH Converter Terminal Isolation

There needs to be a high resistance between the input terminals of the pH converter. Check the converter terminals once or twice a year to confirm that they are not dirty, and have not been affected by condensation or frost.

7.2.2 Check the Display of the pH Converter

Use soft cloth or tissue paper to clean off any dirt on the display of the EXA PH100 pH converter. If required, you may use neutral detergent to remove dirt – but avoid using organic solvents.

8. Troubleshooting

8.1 Unexpected value displayed (narrowing down problem to converter or sensor)



CAUTION

If you request Yokogawa to narrow down the problem to converter or sensor as follows then expenses such as travel to site will be incurred.

A. If you think the displayed value is incorrect

STEP 1.

- Check the KCl level in the sensor
 - (1) For PH10FP: If low, top up with KCl
 - (2) For PH10RP: See STEP 2 below

STEP 2.

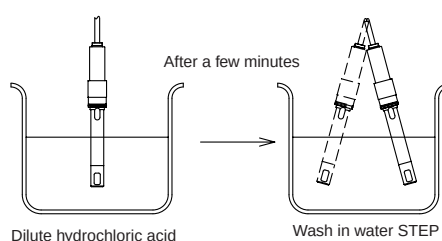
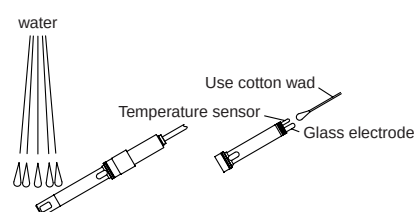
- Check if sensor electrode is dirty.

If dirty, clean the electrode as follows:

- (1) Remove protective cover on tip of sensor
- (2) Use clean water to wash glass electrode, reference electrode, and junction.
- (3) If the stains don't wash off, use cotton wadding
- (4) Chemical (metallic) stains may be removed by dipping for several minutes in dilute hydrochloric then washing.
- (5) If stains on the ceramic junction do not wash off, you may clean the surface with sandpaper.

<Wash periodically>

<If there are metallic stains>



STEP 3.

- Use standard solution or special solution and calibrate

Case 1: If calibration ends normally but displayed value is still abnormal, then electrode life is over.

Case 2: If there are no errors but calibration does not end normally, refer to B. Below.

Case 3: If there are calibration-time errors, refer to C. Below.

B. If you think calibration is not being performed normally

(1) Use a new batch of (standard) calibration solution.

(2) Perform Step 1 and Step 2 in A above.

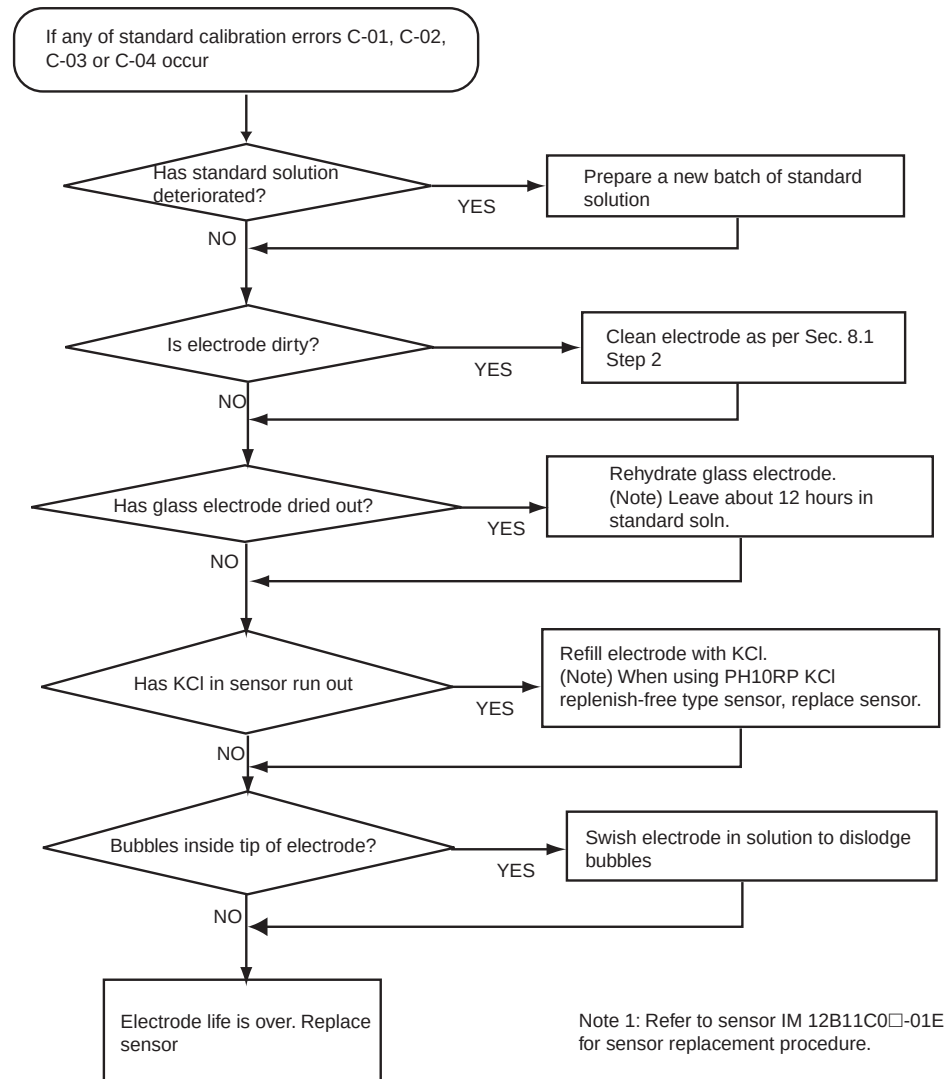
(3) If things don't proceed normally even if calibration is repeated.

The electrode life is over. Get a new one.

If there are calibration-time errors:

Follow the procedure shown in the flow chart below.

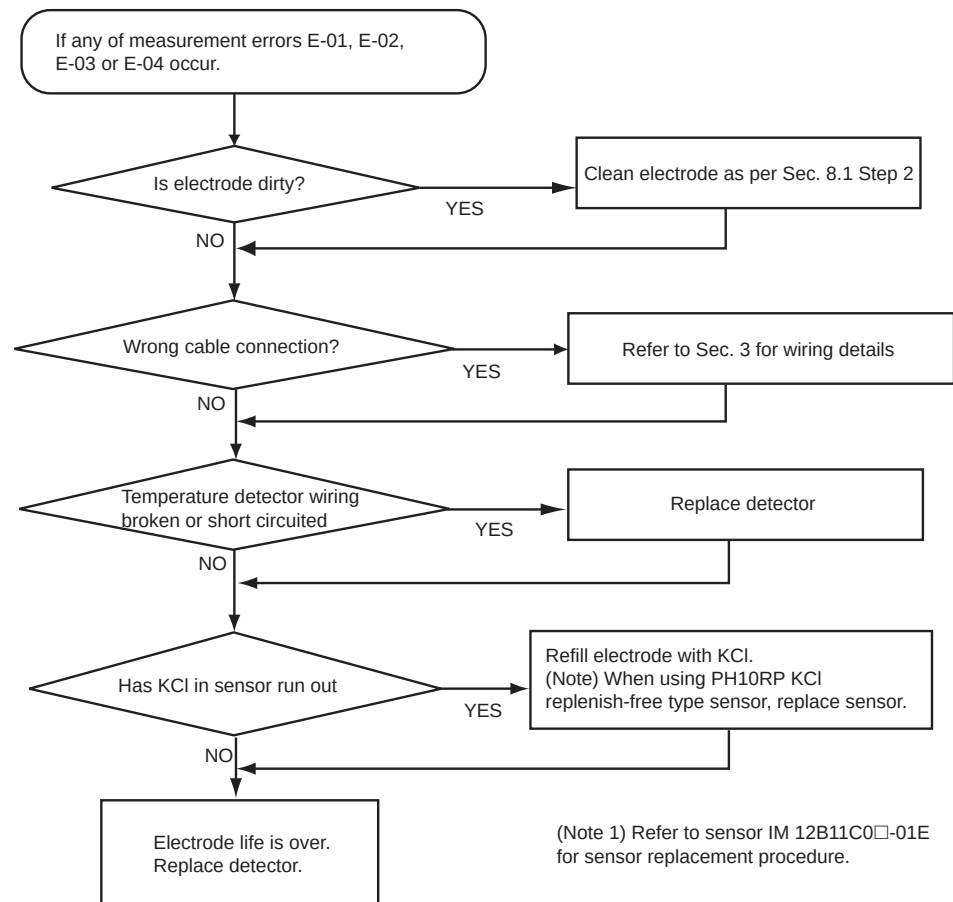
Refer to Sec. 8.2 for error details.



C. If there are measurement-time errors

Follow the procedure shown in the flow chart below.

Refer to Sec. 8.2 for error details.

**D. If replacing sensor does not return things to normal**

- It must be a converter abnormality

**CAUTION**

For a new pH electrode, the error code E-01 may be displayed. This does not indicate a defective sensor; the electrode may need to be soaked in water for a day before it is ready for use.

E. When error E-04 occurs

- Converter is abnormal. Cycle power OFF then ON again, and if the problem persists then send it in for servicing.

**CAUTION**

If you request Yokogawa to remove or replace the converter then expenses such as travel to site will be incurred.

8.2 Error Display

If any abnormality is detected in the EXA PH100 pH converter, a blinking error code is displayed. FAIL contact output may also be set, and any pH converter abnormality is also displayed. If analog output hold is set then burnout downscale (2 mA). The meaning of the different error numbers is as follows:

Table 8.1

Error no.	Aux. display	Error detail
1	E-01	pH measurement out of range
2	E-02	Temperature measurement out of range
3	E-03	Temperature detector abnormal
4	E-04	Converter abnormal

T8.1E.eps

Table 8.2

Error no.	Aux. display	Error detail
1	C-01	Standard solution temperature out of range
2	C-02	Asymmetry potential abnormal
3	C-03	Sensor emf characteristic slope abnormal
4	C-04	Sensor reading unstable

T8.2E.eps

Details of error codes are described below.

8.3 Fixing Error Status

The action you should take when a particular error code is displayed is described below. The error code will not go away unless the error condition is fixed.

8.3.1 Error 1 pH Measurement Out of Range

Aux. display: E-01

[Cause]

The pH measurement is outside the range -2 to 16.

[Cure]

- * Check connection between pH sensor and converter
- * Check the insulation of the cable terminals, and check for corrosion of the electrode.
- * If there is corrosion of the electrode , replace the sensor.

8.3.2 Error 2 Temperature Measurement Out of Range

Aux. display: E-02

[Cause]

The temperature measurement is outside the range -15 to 115°C.

[Cure]

- * Make sure that the measurement liquid is within the above temperature range.(-10 to 110°C)
- * Check the connection between the sensor and converter.
- * If the measurement liquid is within the above temperature range but this error occurs, then the temperature sensor is bad and the pH sensor should be replaced.

8.3.3 Error 3 Temperature Sensor Abnormal

Aux. display: E-03

Note that if the wiring is broken then E-02 is displayed. The display alternates between E-02 and E-03.

[Cause]

May occur if sensor used and converter sensor setting do not agree.

[Cure]

- * Remove temperature sensor from measured liquid, so that it is at room temperature; disconnect cable from converter and measure resistance between terminals of RTD sensor. Check the resistance against that indicated in table 8.3 to check if it's normal.
- * Check that sensor setting in converter agrees with actual temperature sensor used.
- * If connections of pH sensor are normal but reading is still abnormal, the temperature sensor in the pH sensor is probably bad. Replace the pH sensor.

Table 8.3 Resistance of temperature sensor at 25°C

Temperature sensor	Resistance
Pt1000	Approx. 1100Ω
Pt100	Approx. 110Ω
500Ω	Approx. 500Ω
10kΩ	Approx. 10kΩ
6.8kΩ	Approx. 6.8kΩ

T8.3.EPS

8.3.4 Converter Abnormal

Aux. display: E-04

[Cause]

Converter problem.

[Cure]

Turn power OFF then ON again. If this doesn't cure the problem, have Yokogawa service the converter.

8.3.5 Calibration Error

Aux. display: C-01

[Cause]

Temperature of standard solution used for autocalibration is out of range.

For JIS or NIST table, permitted range is 0 to 95°C.

For DIN 19267, permitted range is 0 to 90°C.

For US Technical Buffer Table, permitted range is 0 to 60°C.

For manual calibration, permitted range is -10°C to 110°C.

[Cure]

Make sure that standard solution is within appropriate temperature range above.

8.3.6 Asymmetry Potential Abnormal

Aux. display: C-02

[Cause]

For one-point or two-point calibration, the asymmetry potential is checked and if it is outside the range $\pm 2\text{pH}$ ($\pm 120\text{mV}$) then this alarm occurs.

[Cure]

- * Check if sensor is dirty, clean the electrode if it is.
- * Check that correct standard solution is being used for calibration.
- * If performing calibration manually, maybe a wrong value was entered. Try recalibration.
- * If the above steps do not cure the problem, the sensor is probably at the end of its life, replace it.

8.3.7 Abnormal Slope of sensor emf characteristic

Aux. display: C-03

[Cause]

For two-point calibration, the slope of the sensor characteristic is checked to confirm that it is between 70% and 110%.

[Cure]

- * Check if sensor is dirty, clean the electrode if it is.
- * Check that correct standard solution is being used for calibration.
- * If performing calibration manually, maybe a wrong value was entered. Try recalibration.
- * If the above steps do not cure the problem, the sensor is probably at the end of its life, replace it.

8.3.8 Unstable Sensor Reading

Aux. display: C-04

[Cause]

The sensor reading failed to stabilize within five minutes.

[Cure]

- * Check if sensor is dirty, clean the electrode if it is.
- * If the above step does not cure the problem, the sensor is probably at the end of its life, replace it.

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